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CORRECTIONS

Monthly Weather Review, May 1948, vol. 76, "Climatological Data for May 1948," by sections, p. 93: Pennsylvania least monthly precipitation should be for Coalport, in the amount of 2.58 inches, instead of for Dushore.

Monthly Weather Review, June 1948, vol. 76, "Climatological Data for June 1948," by sections, p. 117: For the New England Section, highest temperature should be for 2 stations, instead of for Framingham, N. H.; the lowest temperature should be Lemington, Vt., 28, on the 6th, instead of that of Mount Washington, N. H.; the precipitation section average should be 4.25, with a departure from normal of +.70, instead of 4.12 with a departure of +.57; the least monthly precipitation should be for Moosehead, Maine, with .84, instead of that for Jackman, Maine.

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AN OBJECTIVE METHOD FOR FORECASTING PRECIPITATION AMOUNTS FROM WINTER COASTAL STORMS FOR BOSTON

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Manuscript submitted February 24, 1948

INTRODUCTION

The problem of precipitation forecasting in New England has been emphasized by the needs of the many varied industries of that region for accurate forecasts when rain or snow is in prospect. Some are especially interested in the type of precipitation, others in amounts. Among those which become extremely dependent upon estimates of the amount of future precipitation in directing their operations are the power and light companies, transportation interests, the U. S. Engineers, and others. Because of this need for forecasting service, the newly established Weather Bureau forecasting research unit at Boston initiated the project described in this paper; the problem of forecasting the type of precipitation was not included in the project, since it is a separate one and fully as complex as that of forecasting amounts.

In this study an attempt was made to combine the techniques of several previous studies and apply them to the particular problem of forecasting for Boston the precipitation amounts to be expected from winter coastal storms. Earlier investigations by Rodgers [1] and by Miller [2], which were concerned with the typing and the recognition of pressure patterns which lead to Atlantic coastal developments included no attempt to evaluate quantitatively the resultant precipitation. Brier [3], however, demonstrated in his study of the T. V. A. Basin that objective techniques could be successfully employed in making quantitative forecasts of precipitation.

This study, patterned loosely after Brier's investigation, was made with a threefold objective:

1. To develop a practical method for computing the precipitation amounts from coastal storms, using data available at the time of the forecast.
2. To show the relative values of the factors contributing to the computation of precipitation amounts.
3. To test the reliability of specific factors now favored by some of the Boston forecasters in determining precipitation amounts.

Briefly, the method employed to gain this objective consisted of choosing several indices in the synoptic field, both at the surface and at upper levels, which were concurrent with the first appearance of a storm in the coastal area. These were related graphically to subsequent amounts of precipitation recorded.

Data used in the study were for the months of November, December, January, February, and March for the five winters of 1942–43, 1943–44, 1944–45, 1945–46, and 1946–47. For an independent check study, data of November 1942, January 1943, December 1944, February 1946, and March 1947, were set aside. These data were selected so that each month would be represented by data from a different year. In all, 96 storms were studied to develop the computation charts and 24 storms to test the results. Although the investigation of precipitation data was restricted to precipitation amounts resulting from coastal storms, it was found that the greater and most important portion of winter precipitation for southern and central New England was covered. Examination showed that 80 percent of the total winter precipitation and nearly all amounts in excess of 0.35 inch resulted from coastal storms. In addition, and somewhat contradictory to the belief that coastal storms are accompanied by heavy amounts of precipitation, actual observation (see Figure 1) showed that in 25 percent of the cases included in the 5-year study the resultant rainfall was less than ¼ inch; in only 25 percent of the cases did the amounts equal 1 inch or more.

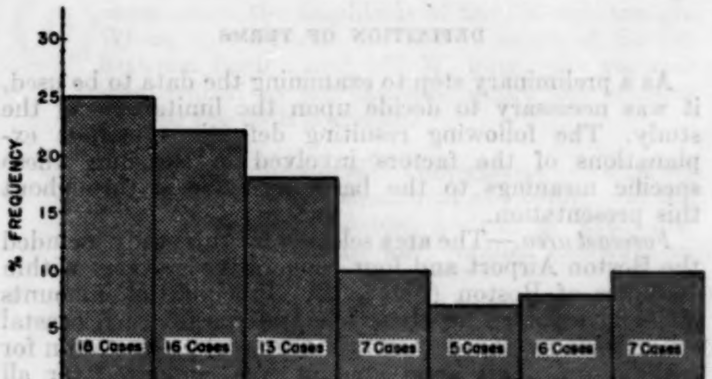

FIGURE 1.—Frequency distribution of observed amounts of precipitation in the Boston area resulting from coastal storms which occurred during the 5-year period of investigation.

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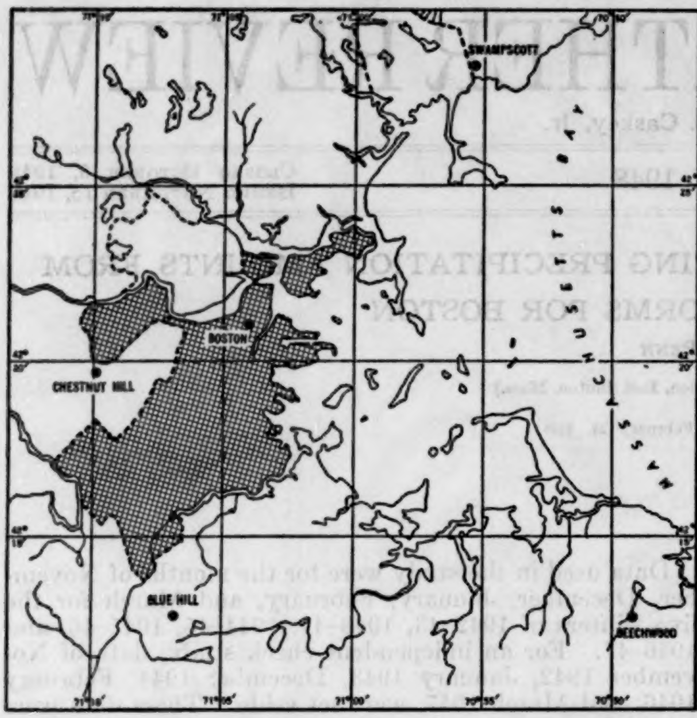

FIGURE 2.—Map showing stations in the Boston area used to obtain representative observed precipitation amounts for coastal storms.

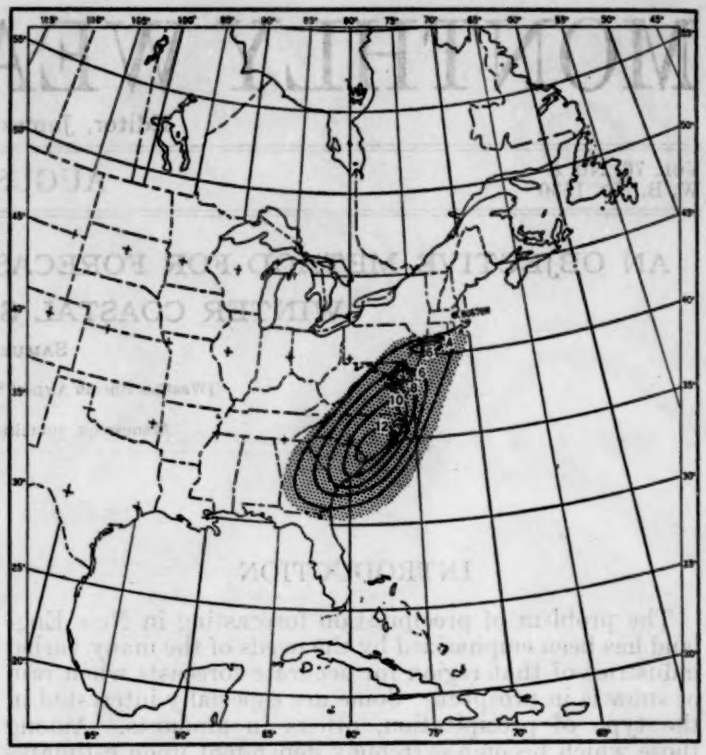

FIGURE 3.—Map with isopleths showing relative distribution of storms within the Atlantic Seaboard area (shaded portion).

It should be pointed out that since not all of the factors affecting precipitation could be evaluated, the computations in this paper yield only an approximate, but nevertheless useful, solution to the forecasting problem. Although encouraging results can be obtained by exclusive use of the suggested techniques, forecasts are often complicated by interactions, accelerations, and developments on the weather map which require considerable subjective consideration. Therefore, the simple, objective technique presented here should not be considered a complete method of forecasting *per se*, but rather an auxiliary tool for the forecaster which will allow him to evaluate properly several of the important meteorological variables. Best results in forecasts, however, can be obtained by not losing sight of the unevaluated factors.

DEFINITION OF TERMS

As a preliminary step to examining the data to be used, it was necessary to decide upon the limitations of the study. The following resulting definitions include explanations of the factors involved in assigning these specific meanings to the basic terms used throughout this presentation.

Forecast area.—The area selected for this study included the Boston Airport and four cooperative stations within 10 miles of Boston (Figure 2). Precipitation amounts officially reported for these five stations for each coastal storm were averaged to obtain the areal precipitation for each storm. This areal amount was computed for all storms which occurred in the 5-year period and was used as the Boston precipitation in the study. For this period it was found that precipitation amounts varied little over the area. The correlation coefficient, for example, between the recorded amounts at Boston and at Chestnut Hill (a cooperative station about 5 miles west) was computed at 0.97.

Precipitation amounts.—These amounts are storm totals rather than fixed-period amounts, since the totals are more significant and useful and they also simplify the study. All precipitation amounts greater than 1.49 inches were classed in one group and assigned the value of 1.50 inches, the value which was used for verification purposes.

Coastal storm.—A coastal storm was defined as the presence at the surface level along the Atlantic Seaboard (shaded area of Figure 3) of either (a) a definite wave formation in the front, (b) a cyclonic wind field, or (c) a closed low. In addition, it was required that there be a center of 3-hourly pressure falls associated with the wave or storm. The study was not limited to storms which originated in the prescribed coastal area but included those which might have moved into the Atlantic Seaboard from any direction. However, of the 125 storms included in the basic and test data, 115 were true secondaries, or new developments within the prescribed area.

In order to determine the favored locations of coastal developments, the area along the Atlantic Seaboard was analyzed with regard to the number of storms found in overlapping sections 2 degrees latitude by 2 degrees longitude in dimension. The value, then of an isopleth at any point in Figure 3 indicates the number of storms whose origin or point of entry into the coastal area was located within a section centered at that point and bounded by meridians and parallels 2 degrees apart. Figure 3 shows that there is an area of maximum occurrence between Hatteras and Charleston and a minor secondary maximum near Long Island.

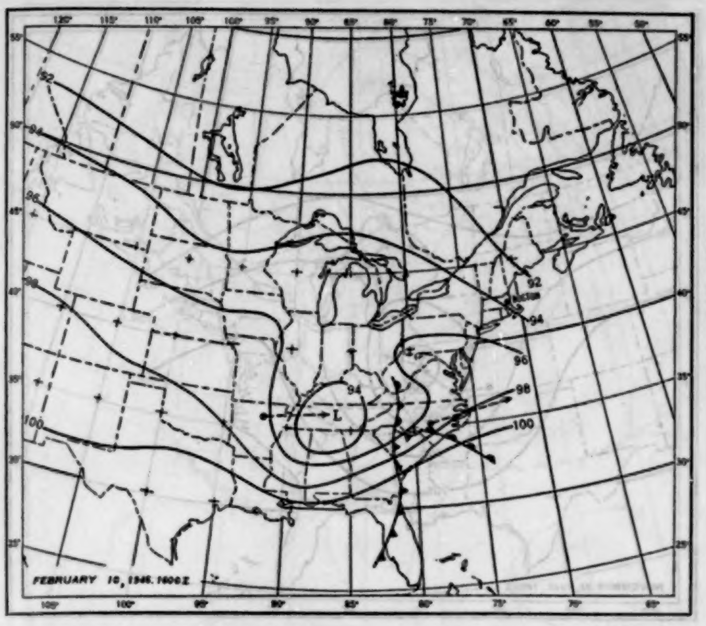

FIGURE 4.—700-mb. chart showing a pressure pattern with a closed low southwest of Boston which would not influence the circulation over Boston. (Arrows and dashed line indicate past 12-hour movement of the low center.)

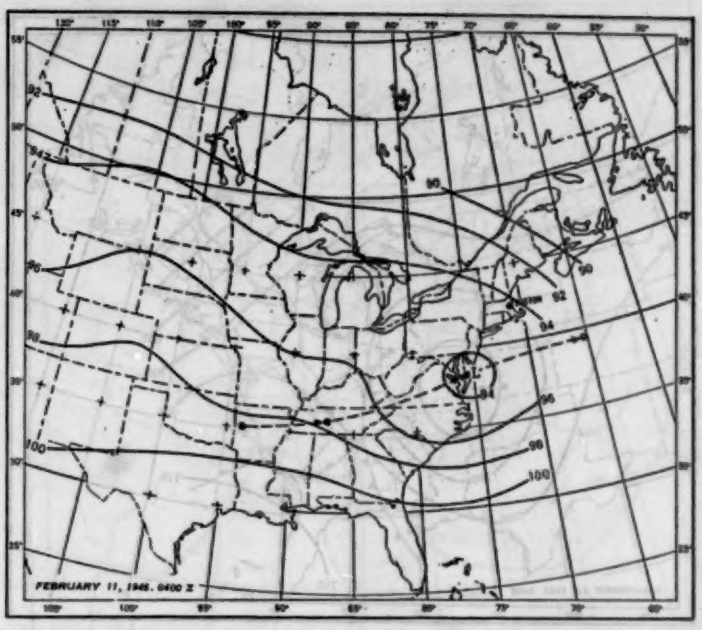

FIGURE 5.—700-mb. chart showing the pressure pattern existing 12 hours later than that in Figure 4. (Arrows and dashed lines indicate past two 12-hour movements of the low center.)

METHOD OF INVESTIGATION

SELECTION OF VARIABLES

In selecting the meteorological variables to be related to observed precipitation amounts, the results of previous research and the experience of other forecasters formed a partial basis for consideration. In one investigation, for instance, Petterssen [4] concluded that coastal storms seem to develop in the lower levels of the atmosphere, where air mass contrasts are greatest and wind fields are most favorable. This conclusion directed attention to the requirement for selecting variables in the lower atmosphere which expressed a measure of the potential strength of developing storms, and those in the upper levels which pointed to the contribution made by the primary storm or trough to the coastal development.

Primarily, however, the independent variables were selected on the basis of a study of many individual storms, using data in each case obtained from the 6-hourly synoptic surface map and the latest available upper-air charts preceding it. To find variables, both at the surface and at upper levels, which appeared to be particularly significant to the problem of forecasting amounts of precipitation, it was necessary to look for those which expressed (a) some indication of the precipitation amounts which occurred near the center of the storm, or (b) some indication of the path of the storm with relation to the forecast area. The latter consideration is, of course, important to the amount of precipitation to be forecast, since it is obvious that the passage of an intense storm far to the east of Boston, for example, will give only a small amount of precipitation at that station.

Finally, the selected independent variables were divided into two groups: (1) the primary variables, which were applied to all storms; (2) the secondary variables, which were applied selectively according to the surface pressure pattern over the eastern portion of the storm map.

Primary variables.—The primary variables were labeled and defined as follows:

X_1 The 850-mb. wind direction immediately over the surface storm. This is a partial measure of the influx of warm, moist air to be expected. In the absence of actual wind observations, this variable was estimated, using pibal data from nearby stations and the geostrophic wind.

X_2 The 700-mb. contour direction immediately over the surface storm. This variable indicates to some extent (a) convergence due to the latitude effect; (b) orientation of the 700-mb. trough; and (c) direction of movement of the surface storm.

X_3 The latitude of the surface storm. The largest amounts of precipitation were found to accompany these storms which develop farthest to the south, other factors being equal.

X_4 The minimum latitude reached by following the 700-mb. contour upwind through Boston no farther than 95° W. long., which indicates to some extent the amplitude of the 700-mb. trough. Where this contour did not go south of Boston between Boston and 95° W. long., the variable was defined as the latitude where the contour crossed the 95th meridian.

Its determination is not objective when a closed low is found to the southwest of Boston, and the contour through Boston, instead of extending southwestward to the low, reaches westward or even northwestward.

Given this situation, the forecaster must decide on the basis of his experience whether Boston will remain in the westerly flow or will come under the influence of the low pressure to the southwest; furthermore, this decision, an all-important one, must be made by the forecaster whether or not he embodies objective techniques in his forecast. For the purpose of this study, however, the value

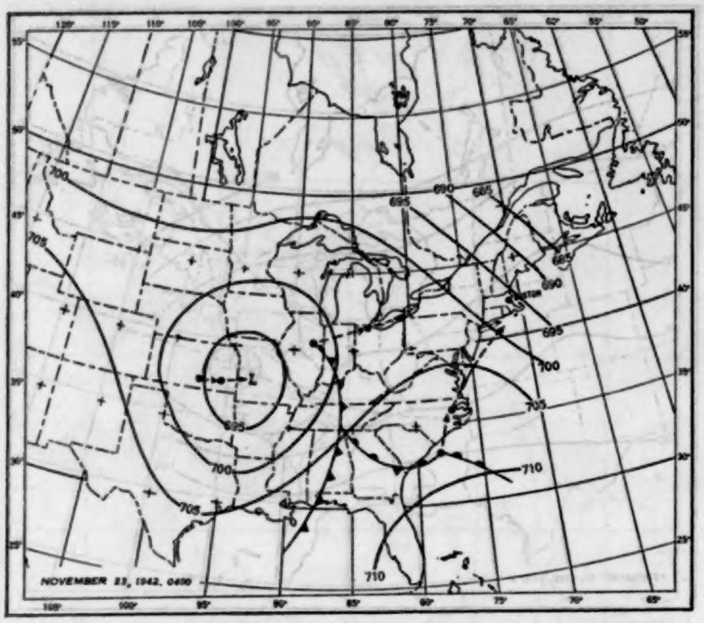

Figure 6.—10,000-foot map showing a pressure pattern with a closed low southwest of Boston which presages a change in the circulation over Boston. (Arrows and dashed lines on left show past two 12-hour movements of low center.)

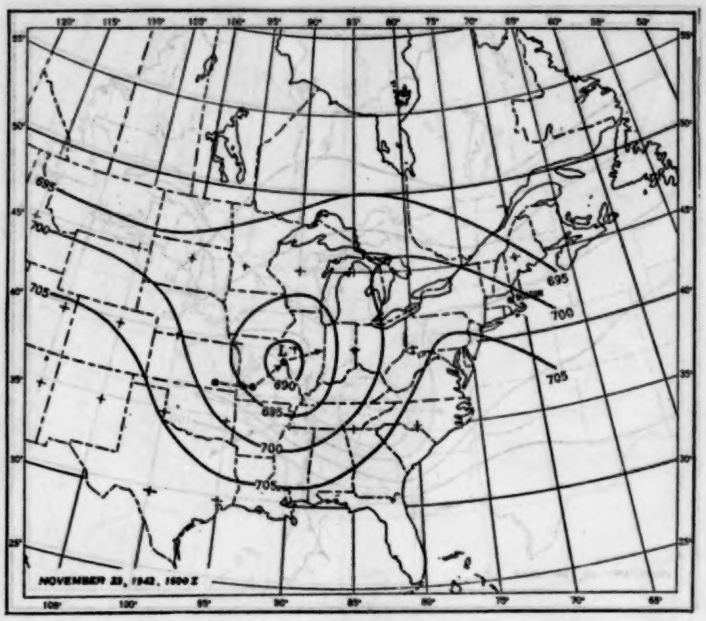

Figure 7.—10,000-foot map showing the pressure pattern existing 12 hours later than that in Figure 6.

X_4 for the 15 cases involving a closed low southwest of Boston (as, for example, those shown in Figures 4 and 6) was determined by looking ahead at subsequent maps, although the forecast procedure would usually be objective and straightforward.

In Figure 4 the arrows and dashed line indicate the previous 12-hour movement of the low, which was rapid and eastward; the easterly circulation of the trough extends only to 38° N. lat. Simple extrapolation of the low pressure movement indicated that it would continue eastward without disturbing the westerly flow over Boston. This was verified by a look at the 700-millibar map 12 hours later (Figure 5). The value for X_4 in this example was 47°.

Figure 6, on the other hand, is an example of an upper-air chart which does presage a change in the circulation over Boston. Here the low (the past two 12-hour movements shown by arrows and dashed lines) is seen to be moving very slowly eastward, and the easterly circulation extends to about 45° N. lat. The value of 32° was assigned to X_4, since the 700-mb. isobar moving up to Boston was expected to become part of the 700-mb. isobar to the southwest. Figure 7, which shows the pressure pattern 12 hours later, verified this.

Secondary variables.—The secondary variables selected were sea level pressure distribution patterns found on storm maps. They were labeled and defined as follows:

Type 1 (a) There is present on the surface map a center of high pressure north or northwest of New England, with a wedge extending southward into New York, Vermont, or New Hampshire;

(b) the past 12-hour movement of the wedge near 45° N. lat., has been 250 miles or less;

(c) the sea level pressure at Caribou, Maine, is at least 15 mb. higher than the pressure at Gander, Newfoundland;

(d) there is a second high-pressure center within 5 degrees of latitude south of Bermuda.

The pressure pattern of Type 1 (exemplified by Figure 8) shows the orientation of the two highs with a col or trough near 32° to 39° N. lat., a favored path for coastal storms. The specific Caribou-Gander pressure difference indicates the presence of the force necessary to propel the storm eastward between the two highs. The greater this difference, the sooner the storm can be expected to recurve, and Type 1 maps are associated with storms which recurve to the east while still south of Long Island. They give southern New England less precipitation than would be forecast using only the primary variables.

Type 2 When the surface map did not fulfill the conditions of Type 1, it was examined for Type 2 criteria. In this type (Figure 9) a center of high pressure must be north of 41° N. lat., and to the north or northeast of the coastal storm. When the high center is east of north with relation to the storm, a westward extension of the ridge must be north of the storm. This pressure pattern

FIGURE 8.—Surface map showing Type 1 pressure distribution, associated with storms that recurve to the east while south of Long Island.

FIGURE 9.—Surface map showing Type 2 pressure distribution, associated with more slowly moving storms.

is necessarily accompanied by slow movement of the storm, due to blocking action of the high. Therefore, Type 2 indicates a longer period of precipitation than would be forecast using only the primary variables. It is interesting to note that only six storms of the 5-year study resulted in precipitation amounts greater than 2 inches, and all six were associated with maps classified as Type 2.

Type 3 All maps not meeting the requirements of Types 1 or 2 were generally classified as Type 3. In this type (Figure 10) the wave was found on the west side of the Atlantic high cell, with no wedge in the apparent path of the storm. Isobars from the wave northward were oriented in a south-north or southwest-northeast direction. Such a pressure distribution favors rapid movement of the storm and therefore lesser amounts of precipitation than would be forecast using only the primary variables.

There are occasionally situations for which it is difficult to distinguish between Type 2 and Type 3 pressure patterns or in which Type 2 is changing to Type 3. In those cases the objective forecast is based only on the primary variables.

CLASSIFICATION OF MAPS WITH RELATION TO PRECIPITATION OCCURRENCE

Before relating the selected variables to observed precipitation amounts, it was necessary to stratify the synoptic surface maps used in the investigation according to whether or not they indicated that precipitation could be expected to occur at Boston. A procedure similar to that used by Brier in his T. V. A. study was employed. Whenever a storm was found in the prescribed coastal area on any surface map, the contour passing through Boston and the one passing through Block Island were each taken from the corresponding 700-mb. chart and traced on the map. When the contouric channel thus delineated on the surface map intersected, east of the 90th meridian, an area of precipitation associated with a low pressure center or a front, the map was placed in Group A; when the contouric channel did not cross such a precipitation area, the map was placed in Group B.

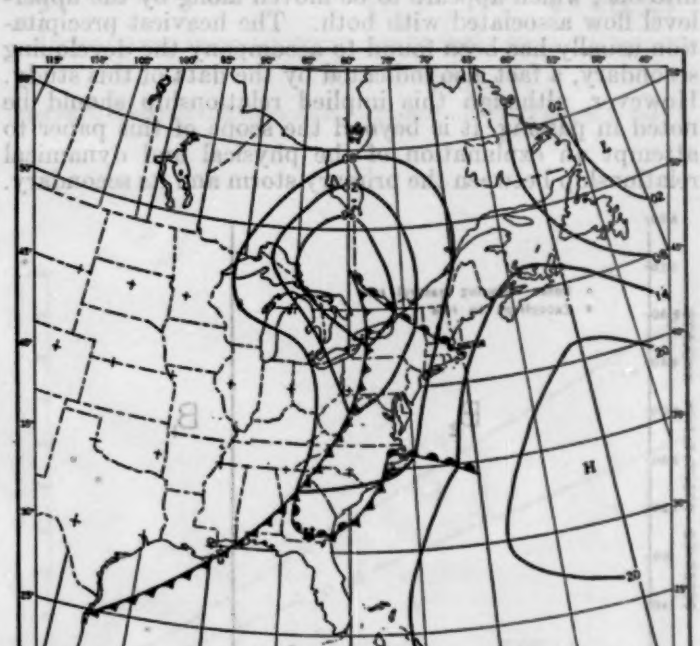

FIGURE 10.—Surface map showing Type 3 pressure distribution, associated with faster-moving storms.

Upon examination it was found that precipitation occurred subsequently at Boston for every Group A case (Table 1), whereas only 6 Group B cases resulted in precipitation, while 24 had none. Obviously, no additional

TABLE 1.—*Preliminary stratification of storm maps into those showing occurrence and nonoccurrence of precipitation*

	Map group A	Map group B
Precipitation	66	6
No precipitation	0	24

subdivision of Group A cases was necessary, but Group B cases needed further stratification. This was accomplished by plotting graphically the minimum latitude reached by the 700-mb. contour through Boston, variable X_4, against recorded amounts of precipitation. Figure 11 shows that all but two cases were followed by precipitation when X_4 was 38° or less, whereas only one case was followed by precipitation when X_4 was greater than 38°, and then the amount was only 0.07 inch. Therefore, those cases in which X_4 was 38° or less were relabeled Group B_1, and together with Group A cases were used in applying the selected primary and secondary variables to determine amounts of precipitation to be expected. Those cases having an X_4 value greater than 38° were relabeled Group B_2, and a forecast of no precipitation was assigned to them.

Since application of the criterion described above depended upon precipitation areas as far west as the Mississippi River, it suggested that a close relationship exists between primary and secondary storms. Previously, other investigators, including Brunt [5] and Austin [6], have pointed to a close relationship existing between the deepening of the wave and its accompanying cloudiness and precipitation. Petterssen, Austin, et al. [7] and others [8, 9] have also investigated many aspects of secondary cyclones on the Atlantic Coast. Experience too has supported this implied relationship, since it has shown that the two belts of precipitation associated with the primary and secondary storms, respectively, often merge into one, which appears to be moved along by the upper-level flow associated with both. The heaviest precipitation usually has been found to accompany the developing secondary, a fact also indicated by the data of this study. However, although this implied relationship should be noted in passing, it is beyond the scope of this paper to attempt an explanation of the physical and dynamical relationship between the primary storm and its secondary.

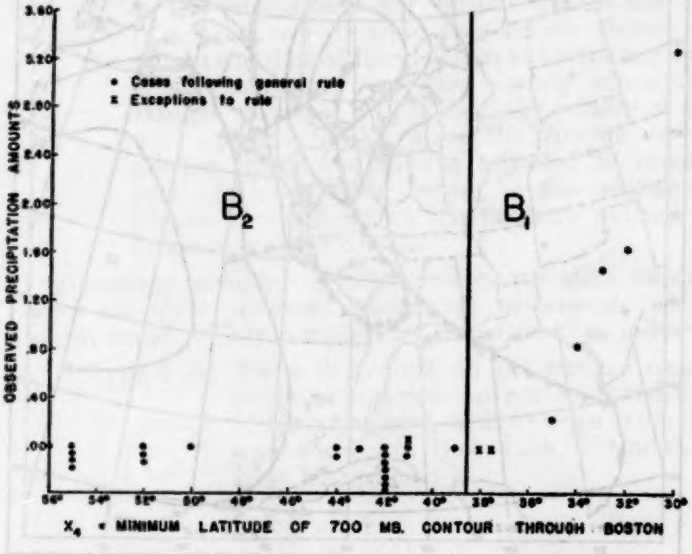

FIGURE 11.—Stratification of B map cases (see Table 1) into B_1 and B_2 cases by application of variable X_4.

CONSTRUCTION OF COMPUTATION CHARTS

Application of the variables to recorded precipitation amounts for the storms connected with the A and B_1 map classifications was accomplished in the manner shown in the schematic diagram of Figure 12. The general procedure was to work with the variables in pairs. For example, the terms X_1 and X_2 were used to derive the function Y_1; terms X_3 and X_4 were used to derive the function Y_2. In turn, these functions, Y_1 and Y_2 were combined to obtain the function Z, which was then modified, when necessary, by applying the appropriate secondary variable. The final result was the computed precipitation amount, C.

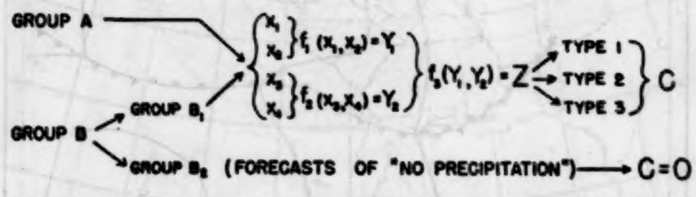

FIGURE 12.—Schematic working plan showing the steps in making an objective forecast from the preliminary classification of the map to the final computation of precipitation forecast value C.

The specific procedure in determining the dependence of precipitation amounts upon the several variables involved three steps. First, for each case the value of X_1 was plotted as the abscissa and the corresponding value of X_2 as the ordinate on a scattergram, and the point was labeled with the observed precipitation amount (Figure 13). Secondly, the scattergram was then marked off into cells of several observations each, with the mean of each cell entered in large figures within its limits. Thirdly, isopleths of precipitation amounts were drawn to these mean figures, keeping the lines as smooth as possible. From the isopleths in Figure 13 it is evident that X_1 (the 850-mb. wind direction above the storm) and X_2 (the 700-mb. contour direction over the storm) exert about equal effects upon the precipitation amounts.

Using X_3 and X_4 in place of the former variables, Figure 14 was constructed in the same manner. Since the isopleths in most portions of the chart tend to approach the horizontal, it can be assumed that the influence of X_3 (the latitude of the surface storm) generally is not as effective as X_4 (the minimum latitude of the 700-mb. contour through Boston).

Figure 15 shows the derivation of the function Z, determined by plotting functions Y_1 and Y_2 against each other, and indicating on the chart the corresponding amounts of observed precipitation. Isopleths of amounts were drawn, using the technique applied to the two previous charts.

The function, Z, thus derived from computation based on the four primary variables, was then modified by application of the appropriate secondary variable. Figure 16 was constructed with reference to modification necessary in Type 1 cases (see Figure 8). In this diagram the computed amounts of precipitation (Z values) were plotted against the observed amounts, with the corresponding values of the Caribou-Gander sea level pressure differences indicated. Two isopleths were drawn by inspection, one for 15 mb., and one for 20 mb. The 20-mb. curve was used for all values 20 mb. or greater; pressure differences below 15 mb. did not, by definition, fall into the Type 1 classification. Since the ordinate of this diagram expresses the final corrected values (as well as observed amounts), the chart is entered by following the line for the computed Z value upward until it intersects the proper pressure-difference curve. The ordinate

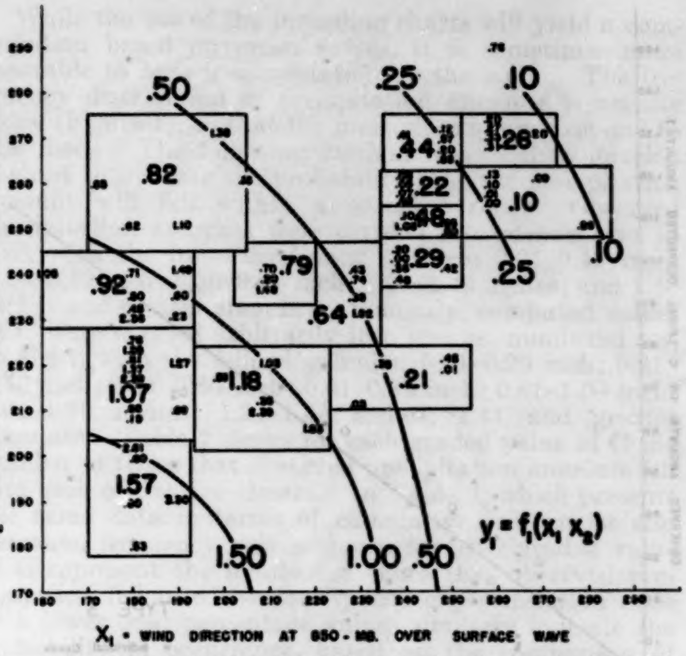

FIGURE 13.—Chart showing derivation of Y_1, a function of primary variables X_1 and X_2.

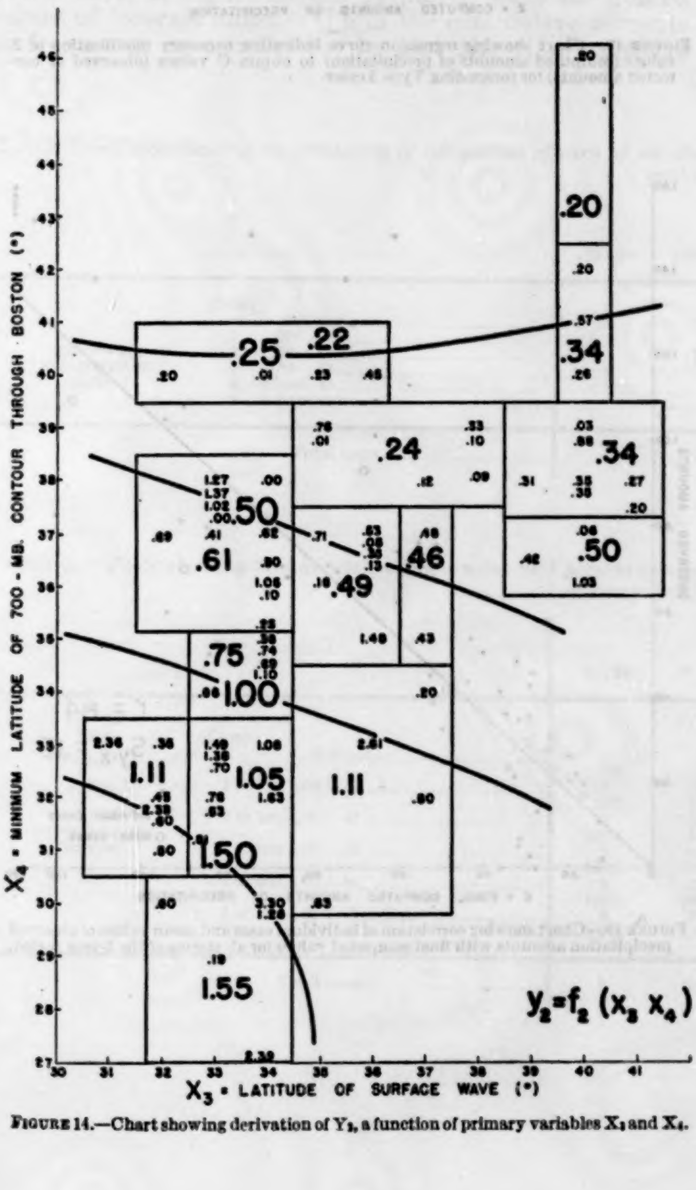

FIGURE 14.—Chart showing derivation of Y_2, a function of primary variables X_3 and X_4.

value at this point of intersection represents the final computed precipitation amount (C) to be forecast. The slope of each of these pressure curves is less than one, indicating that too much precipitation would be forecast using only the primary parameters, unmodified by application of the secondary variables. This effect—precipitation amounts less than the average for coastal storms—would be expected from a Type 1 pressure field.

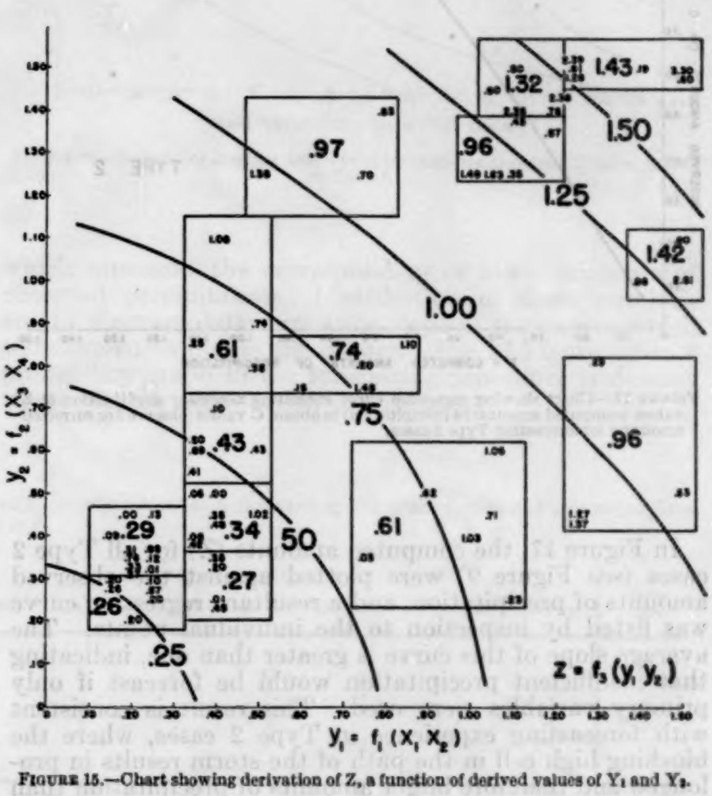

FIGURE 15.—Chart showing derivation of Z, a function of derived values of Y_1 and Y_2.

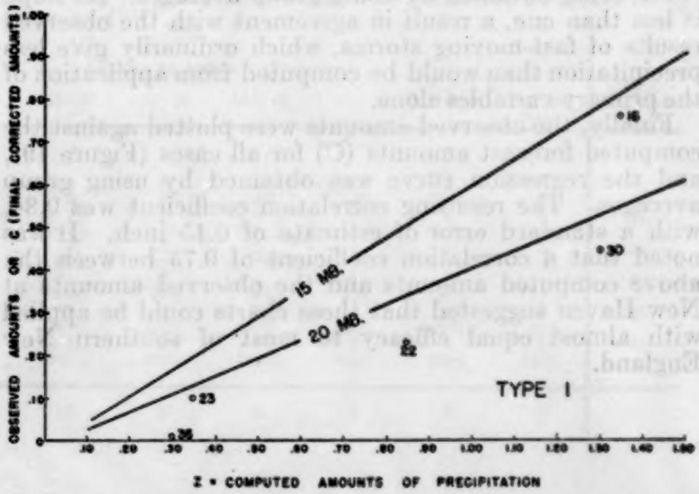

FIGURE 16.—Chart showing isopleths indicating necessary modification of Z values (computed amounts of precipitation) to obtain C values (observed or corrected amounts) for forecasting Type 1 cases.

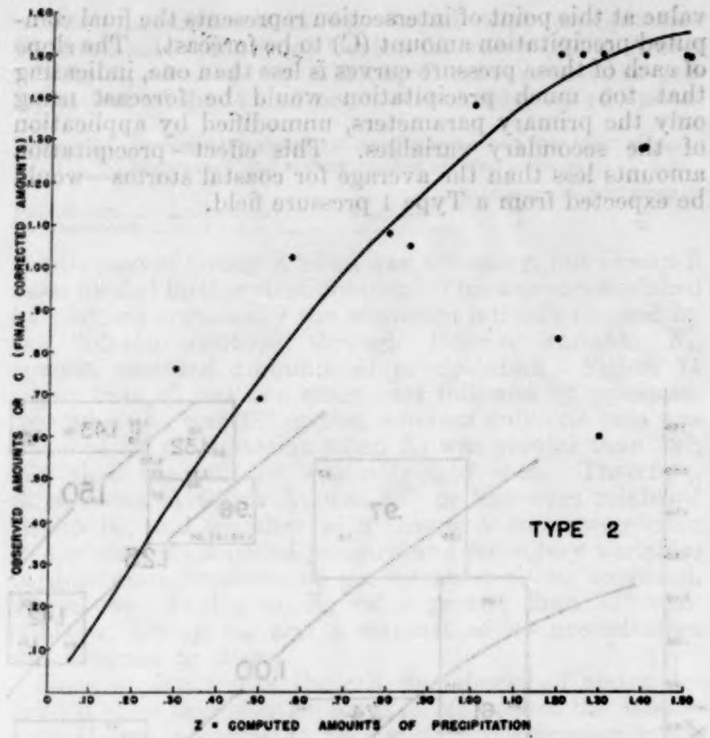

Figure 17.—Chart showing regression curve indicating necessary modification of Z values (computed amounts of precipitation) to obtain C values (observed or corrected amounts) for forecasting Type 2 cases.

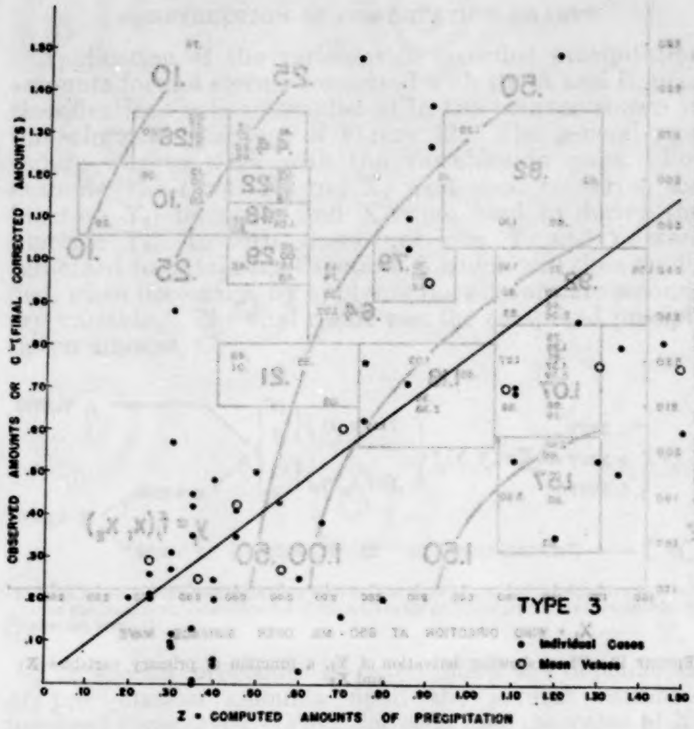

Figure 18.—Chart showing regression curve indicating necessary modification of Z values (computed amounts of precipitation) to obtain C values (observed or corrected amounts) for forecasting Type 3 cases.

In Figure 17, the computed amounts (Z) for all Type 2 cases (see Figure 9) were plotted against the observed amounts of precipitation, and a resultant regression curve was fitted by inspection to the individual points. The average slope of this curve is greater than one, indicating that insufficient precipitation would be forecast if only primary variables were used. This result is consistent with forecasting experience in Type 2 cases, where the blocking high cell in the path of the storm results in prolonged and therefore larger amounts of precipitation than are otherwise indicated.

Figure 18, for Type 3 cases (see Figure 10), was also constructed by plotting the computed amounts against the observed amounts of precipitation, the regression curve being obtained by using group averages. Its slope is less than one, a result in agreement with the observed results of fast-moving storms, which ordinarily give less precipitation than would be computed from application of the primary variables alone.

Finally, the observed amounts were plotted against the computed forecast amounts (C) for all cases (Figure 19), and the regression curve was obtained by using group averages. The resulting correlation coefficient was 0.84, with a standard error of estimate of 0.15 inch. It was noted that a correlation coefficient of 0.73 between the above computed amounts and the observed amounts at New Haven suggested that these charts could be applied with almost equal efficacy to most of southern New England.

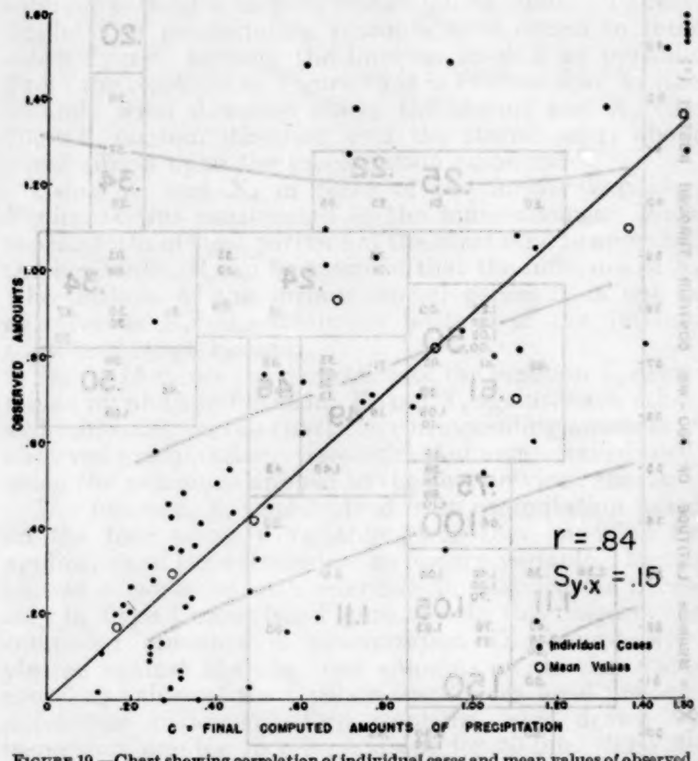

Figure 19.—Chart showing correlation of individual cases and mean values of observed precipitation amounts with final computed values for all storms of the 5-year period.

While the use of the preceding charts will yield a computation based on mean values, it is sometimes more desirable to base a computation on the mode. The frequency distribution of precipitation amounts is usually skew (Figure 1), so that the mean does not correspond to the mode. The following method was used to develop a chart to indicate the probability that the precipitation amount will fall within a specified range. Observed precipitation amounts were divided into classes zero to five, with the following limits: 0–trace; 0.01–0.19 inch; 0.20–0.49 inch; 0.50–0.99 inch; 1.00–1.49 inches; and 1.50 inches and greater amounts. Similarly, computed values of C were divided arbitrarily into groups, numbered one to eight, with the following limits: 0.01–0.20 inch; 0.21–0.40 inch; 0.41–0.60 inch; 0.61–0.80 inch; 0.81–1.00 inch; 1.01–1.20 inches; 1.21–1.40 inches; 1.41 and greater amounts. Table 2 shows for each graded value of C the number of times that observed precipitation amounts fell into each of the five classes. In Table 3, which presents the same data in terms of cumulative frequencies and percents, frequency values shown for each graded value of C represent the number of times that observed precipitation fell into the corresponding precipitation class or a lower one; percentage values similarly indicate the probability of occurrence, based on the comparison of observed and computed amounts for these 73 cases. From Table 3, Figure 20 was prepared, using the graded values of forecast amount C and the cumulative percents of frequency as coordinates to plot the class numbers which represent the corresponding or lower amounts of observed precipitation. Distribution of these numbers on the diagram determined the slope of the curves which were drawn to divide the classes. Use of Figure 20 as a probability graph in the forecasting procedure is demonstrated in the next section of this paper.

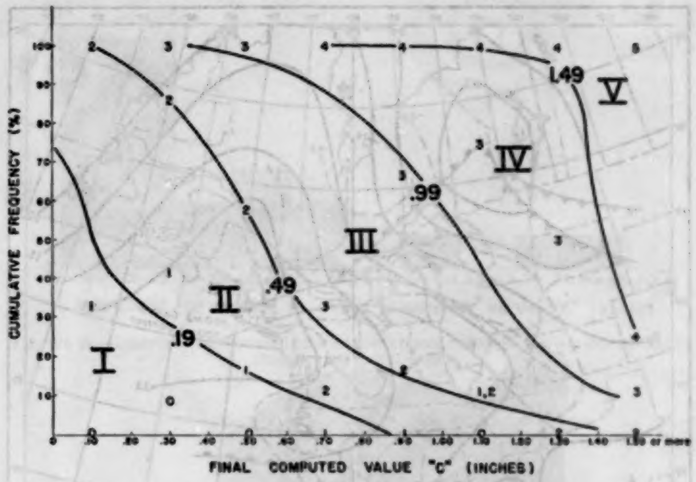

FIGURE 20.—Probability chart for determining precipitation class from C value, based on Table 3.

TABLE 2.—*Table showing the frequency of occurrence of each of six classes of precipitation as a function of the graded values of computed forecast value C*

	Class		GRADED VALUES OF C (Inches) .01-.20	.21-.40	.41-.60	.61-.80	.81-1.00	1.01-1.20	1.21-1.40	1.41 up	Total cases
OBSERVED PRECIPITATION (Inches)	0	0-Trace	0	2	0	0	0	0	0	0	2
	1	.01-.19	2	7	2	0	0	1	0	0	12
	2	.20-.49	4	10	5	1	1	0	0	0	21
	3	.50-.99	0	3	5	2	3	5	1	1	20
	4	1.00-1.49		--------	--------	6	2	2	1	1	12
	5	1.50 or more		--------	--------	--------	--------	--------	--------	6	6
		Total cases	6	22	12	9	6	8	2	8	73

TABLE 3.—*Table showing the cumulative frequencies and percentages of occurrence of six precipitation classes as a function of the graded values of computed forecast value C*

	Class		GRADED VALUES OF C (Inches) .01-.20	.21-.40	.41-.60	.61-.80	.81-1.00	1.01-1.20	1.21-1.40	1.41 and more	Cumulative totals
OBSERVED PRECIPITATION (Inches)	0	0-Trace	0 0%	2 9%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	2
	1 or less	.00-.19	2 33%	9 41%	2 17%	0 0%	0 0%	1 12%	0 0%	0 0%	14
	2 or less	.00-.49	6 100%	19 86%	7 58%	1 11%	1 17%	1 12%	0 0%	0 0%	35
	3 or less	.00-.99	6 100%	22 100%	12 100%	3 33%	4 67%	6 75%	1 50%	1 12%	55
	4 or less	.00-1.49	6 100%	22 100%	12 100%	9 100%	6 100%	8 100%	2 100%	2 25%	67
	5 or less	.00-1.50 and more	6 100%	22 100%	12 100%	9 100%	6 100%	8 100%	2 100%	8 100%	73
		Total cases	6	22	12	9	6	8	2	8	73

FIGURE 21.—Surface map used in example of objective forecast. Shaded area indicates where precipitation was occurring.

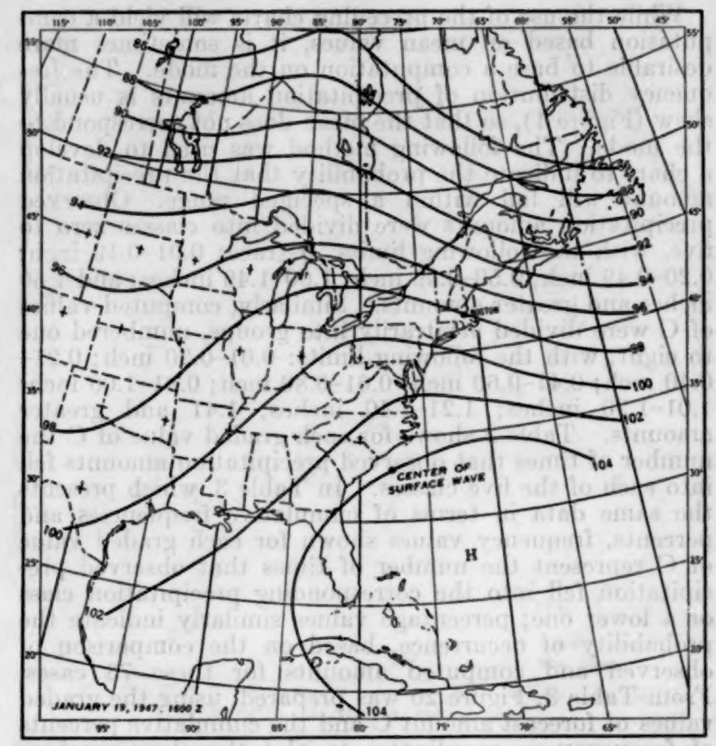

FIGURE 22.—700-mb. chart used in example of objective forecast, with location of surface pressure wave indicated.

EXAMPLE OF AN OBJECTIVE FORECAST

By using these constructed charts, at the time the storm first appears in the prescribed coastal area, the forecaster can compute the precipitation to be expected from a coastal storm. The routine of the computation for the objective forecast can be demonstrated by reference to the synoptic situation of January 19, 1947, at 1330 E. S. T. Figures 21, 22, and 23, show, respectively, the surface map, 700-mb. chart, and 850-mb. chart for this date.

1. Since precipitation is occurring upstream within the 700-mb. contouric channel, this case belongs in Group A.
2. Primary variables determined from these charts have the following values:

   $X_1=170°=$850-mb. wind direction above wave at 33° N., 77–1/2° W. (Figure 23)
   $X_2=240°=$700-mb. contour direction above wave (Figure 22)
   $X_3=33°=$latitude of surface storm (Figure 21)
   $X_4=36.5°=$minimum latitude (east of 95° W. long.) of 700-mb. contour line through Boston (Figure 22)
3. The pressure pattern, similar to that shown in Figure 9, indicates a Type 2 classification with reference to the secondary variables.
4. The derived functions and values determined from these parameters follows:

   $Y_1=1.10$ (from Figure 13, using X_1 and X_2)
   $Y_2=0.60$ (from Figure 14, using X_3 and X_4)
   $Z=0.90$ (from Figure 15, using Y_1 and Y_2)
   $C=1.19$ (from Figure 17)

   The computed precipitation amount of 1.19 inches for the forecast compares favorably with the observed amount for this storm, which was 1.05 inches.
5. Figure 20 is used to obtain an indication of the most likely class in which the precipitation will occur; from this chart the following is noted, when $C=1.19$ inches:

   (a) There is a zero chance that the amount of precipitation will be 0.19 inch or less.
   (b) There are 6 chances in 100 that the amount will be 0.49 inch or less.
   (c) There is a 30-percent chance that the amount will be 0.99 inch or less; and 24 (30 minus 6) chances in 100 that the amount will be greater than 0.49 inch and less than 1.00 inch.
   (d) There are 99 chances in 100 that the amount will be 1.49 inches or less; and there are 69 (99 minus 30) chances in 100 that the observed amount will be greater than 0.99 inch and less than 1.50 inches.
   (e) There is only one chance (100 minus 99) in 100 that the observed amount will be greater than 1.49 inches.

The highest probability, when $C=1.19$ inches, is for the precipitation amount to occur in Class IV (1.00–1.49 inches). The amount actually observed, 1.05 inches, is in this group.

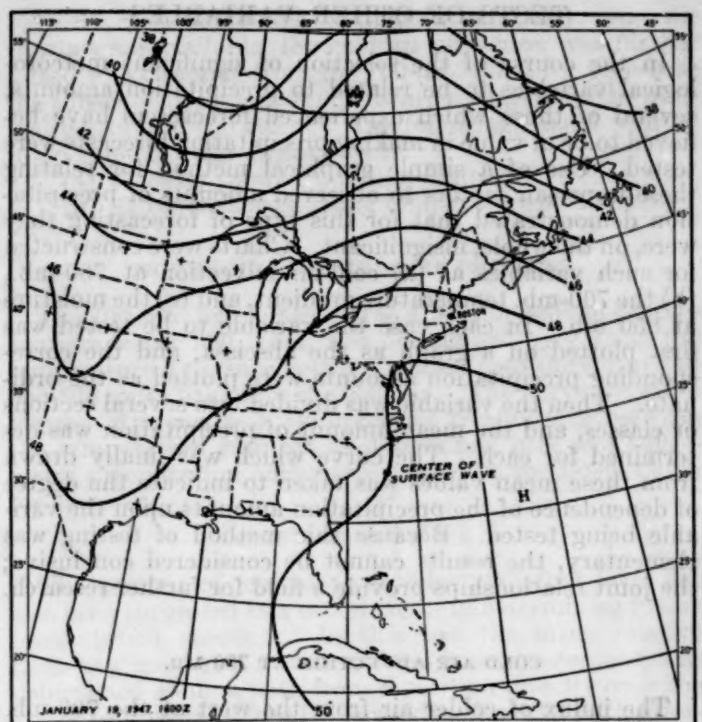

FIGURE 23.—850-mb. chart used in example of objective forecast, with location of surface pressure wave indicated.

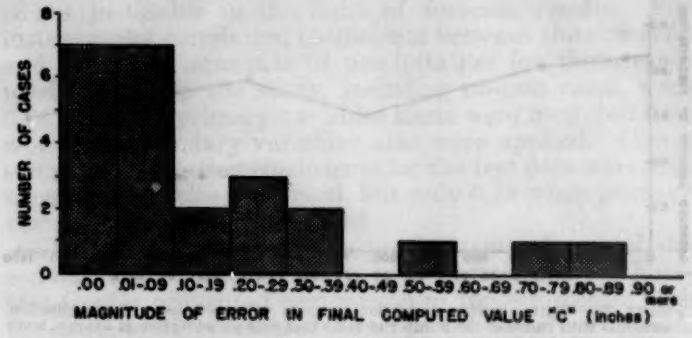

FIGURE 24.—Distribution of errors in computed forecast value, C, for 24 cases of coastal storms used as test data.

TEST OF METHOD ON INDEPENDENT DATA

The 24 storms included in the test data contained 16 cases in the Group A map classification or in Group B_1 (all followed by precipitation at Boston), and 8 cases in Group B_2. Seven of the latter resulted in no precipitation at Boston, and one (February 24, 1946) was followed by 0.02 inch.

Data for all variables of these 24 test cases and resulting computed forecast amounts are shown in Table 4. The correlation between the observed and forecast amounts (last two columns) was 0.85, and the standard error of estimate was 0.29 inch. Figure 24, the distribution of errors in the 24 tests forecasts, shows that when only the 16 cases involving precipitation were considered, the correlation between computed forecast amounts and observed amounts was 0.71, and the standard error of estimate was 0.36 inch. The significance of the secondary variables is indicated by the fact that the correlation of 0.71 is reduced to 0.58 when these variables are not used.

Table 5 is a contingency table based on the probability curves of Figure 20, as applied to the computed (C) values of the 24 test cases. This tabulation reveals 14 cases having no class error; 8 involving 1 class error; only 2 cases erring by 2 classes; and none with greater errors.

TABLE 4.—*Tabulation of computations made for forecasting 24 test cases, and corresponding observed precipitation amounts*

Date	Time (Z)	Map group	Variables							ΔP*	Pressure type	Computed amounts (C)	Observed amounts
			X_1	X_2	Y_1	X_3	X_4	Y_2	Z				
March 1947													
1	0600	A	210	260	0.50	31	36	0.80	0.65	....	2	0.93	1.50
8	0600	B_2	....	....	....	....	....	....	....	....	....	.00	T
11	1200	B_2	....	....	....	....	....	....	....	....	....	.00	.00
19	1800	B_2	....	....	....	....	....	....	....	....	....	.00	.00
28	0000	B_2	....	....	....	....	....	....	....	....	....	.00	.00
February 1948													
6	1200	A	230	250	.40	35	35	.75	.60	....	3	.48	.59
10	1800	B_2	....	....	....	....	....	....	....	....	....	.00	.00
19	1800	A	170	220	1.25	35	34	.90	1.10	....	3	.86	1.08
23	0000	A	260	270	.15	38	50	.10	.15	20	1	.05	.05
24	0600	B_2	....	....	....	....	....	....	....	....	....	.00	.02
26	1800	A	260	270	.15	40	38	.35	.30	....	3	.25	.25
28	0000	A	230	250	.40	40	35	.50	.45	....	2	.67	.85
December 1944													
8	0000	A	190	210	1.30	33	29	1.50	1.50	....	3	1.16	.38
11	0600	A	180	230	1.20	32	30	1.50	1.50	....	2	1.50	1.16
19	0000	A	270	260	.15	39	42	.20	.20	....	2	.29	.30
27	1800	A	230	250	.40	36	37	.45	.45	....	2	.67	.76
29	1800	B_2	....	....	....	....	....	....	....	....	....	.00	.00
November 1942													
3	0000	A	250	250	.30	38	30.5	.35	.35	....	3	.29	.69
23	1200	B_1	190	230	1.10	32	32	1.40	1.35	....	2	1.50	1.50
January 1943													
4	0600	A	250	250	.30	39	39	.35	.35	15	1	.20	.44
8	0600	B_2	....	....	....	....	....	....	....	....	....	.00	.00
18	1200	A	260	270	.15	38	33	.90	.60	....	2	.87	.89
28	0600	A	180	210	1.40	33	28	1.50	1.50	....	2	1.50	1.49
30	1200	A	240	240	.40	33	30	1.50	1.10	....	2	1.37	.56

* Pressure difference between Caribou, Maine, and Gander, Newfoundland, taken from surface map.

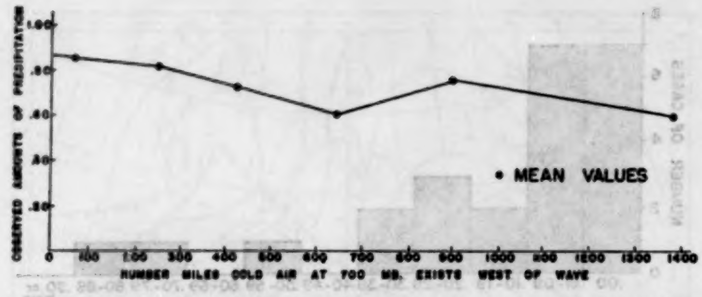

Figure 25.—Charts showing correlation of mean values of observed precipitation amounts with values of the number of miles that cold air advection at 700-mb. level extends west of surface pressure wave.

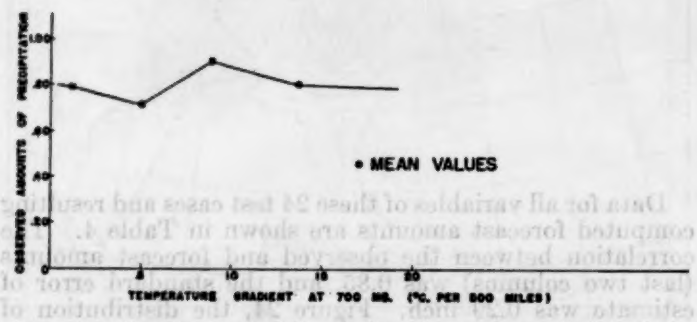

Figure 26.—Chart showing correlation of values of temperature gradient at 700-mb. level with mean values of observed amounts of precipitation.

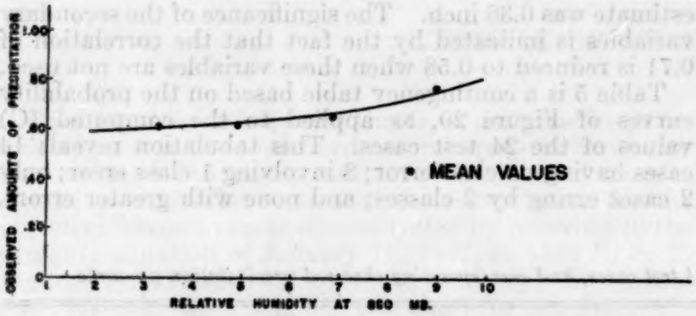

Figure 27.—Chart showing correlation of mean values of observed relative humidity at 850 mb. with mean values of observed precipitation amounts.

TESTS OF OTHER VARIABLES

In the course of the selection of significant meteorological variables to be related to precipitation amounts, several of those which experienced forecasters have believed to be of value in making precipitation forecasts were tested. Use of a simple graphical method for relating these upper-air factors to observed amounts of precipitation demonstrated that for this type of forecasting they were, on the whole, insignificant. Charts were constructed for such variables as (a) cold-air advection at 700-mb., (b) the 700-mb. temperature gradient, and (c) the moisture at 850 mb. In each case the variable to be tested was first plotted on a graph as the abscissa, and the corresponding precipitation amounts were plotted as the ordinate. Then the variable was divided into several sections or classes, and the mean amount of precipitation was determined for each. The curve which was finally drawn from these mean values was taken to indicate the degree of dependence of the precipitation amounts upon the variable being tested. Because this method of testing was elementary, the results cannot be considered conclusive; the joint relationships provide a field for further research.

COLD AIR ADVECTION AT 700 MB.

The influx of colder air from the west at the 700-mb. level has been suspected by forecasters of being the explosive necessary to set off wave developments. The subsequent advection of colder air to a position over the warm coastal waters has been assumed to have two major effects: (a) of increasing the potential energy of the area; (b) of increasing the vertical instability of the air (that is, the steepening of the temperature lapse rate). Since both effects might probably lead to increased precipitation, a test of the effect of this variable on precipitation amounts was made, following the graphical method outlined above. Figure 25 is the graph resulting from plotting the observed precipitation against the number of miles the cold air advection at 700 mb. extended west of the surface wave, as determined from the orientation of isotherms and contours. Contrary to the belief prevalent among forecasters, this diagram indicates little relationship between the proximity of cold air advection at 700 mb. and subsequent precipitation amounts at Boston.

Table 5.—*Contingency table based on the probability curves of Figure 20, for the 24 test cases*

		Computed precipitation (Inches)						
		0—Trace	.01—.19	.20—.49	.50—.99	1.00—1.49	1.50 or more	Total cases
Observed precipitation (Inches)	0—Trace	7						7
	.01—.19	1	1					2
	.20—.49		1	2		1		4
	.50—.99			2	3	1		6
	1.00—1.49				1		2	3
	1.50— or more				1		1	2
	Total cases	8	2	4	5	2	3	24

In 61 cases for which completely analyzed upper-air charts were available, the cold air advection was further tested by extracting from the 700-mb. chart for each case the subsequent 12-hour temperature change over the original position of the storm. The following results pointed to no generally significant effect.

(a) 27 cases showed a falling temperature change.
(b) 34 cases showed rising temperature or no change.

THE 700-MB. TEMPERATURE GRADIENT

The 700-mb. temperature gradient, expressed in degrees centigrade per 500 miles, was determined by getting the temperature difference between a point near the storm and one 500 miles back into the cold air. The curve shown in Figure 26 indicates little apparent relationship between the temperature gradient as determined here and subsequent precipitation amounts recorded in the Boston area for 43 cases.

MOISTURE AT 850 MB.

The amount of moisture near the 5,000-foot level has also been suggested as a useful factor in determining future precipitation amounts. In this test the mean relative humidity, used as a measure of the moisture content, was determined along a path from a position directly over the storm to a point 300 miles upwind, unless the path intersected the trough in a shorter distance; in that event, the mean relative humidity was determined only as far as the trough. The plotted curve of Figure 27, based on 61 cases, shows that the relative humidity measured in this way has little relationship to the precipitation amounts. Substitution of mixing ratio for the relative humidity gave similar negative results.

ADDITIONAL VARIABLES

Several other variables tested were: (a) the distance between the forecast area and the path of the storm, measured along a line normal to the storm path; (b) the deepening of the storm between the time of beginning of the forecast period and the time the storm passes the forecast point; (c) the length of the precipitation period. These three variables were found to be significantly related to the precipitation amounts. Unfortunately, these variables, which themselves must be forecast, are usually as difficult to determine as is the precipitation amount.

CONCLUSIONS

The results of this study clearly demonstrate that objective techniques can be utilized advantageously in forecasting precipitation amounts for winter coastal storms. Parameters X_1 (the 850-mb. wind direction above the storm), X_2 (the 700-mb. contour direction over the storm), X_3 (the latitude of the surface storm), and X_4 (the minimum latitude of the 700-mb. contour through Boston) are all significant factors that can be easily determined and effectively used for objective forecasts. However, it is also evident that the introduction of the secondary variables entails some loss in simplicity and objectivity of method, upon which so much emphasis has been laid, although elimination of the secondary variables is not justifiable in the light of forecast results. For instance, the correlation coefficients between the observed and computed amounts of precipitation for those cases used to develop the study, including no-rain cases, were 0.74 when the primary variables alone were used, but 0.84 when the secondary variables also were applied. Corresponding correlation coefficients for the test data were 0.85 when all variables were used, but only 0.78 when primary variables alone were employed.

The fixed periods and the precipitation classes of the conventional, official forecasts issued by the Boston Forecast Center prevented comparison of those forecasts with the storm total forecasts obtained by the objective method. However, the correlation of 0.85 for the test cases might be compared with the 0.69 correlation Brier obtained in his application of objective techniques for the T. V. A. Basin forecasts.

The seemingly insignificant relationship between the precipitation amounts and some of the upper-air factors must be interpreted with caution. The results, which apply only to this study, do not necessarily lend themselves to generalization.

There are, of course, other factors influencing quantitative precipitation which have not been utilized in this study. Some, such as the processes of vertical motion and divergence, still await some effective means of measurement.

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METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR AUGUST 1948

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during August 1948*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,004.5 mb.)				Albuquerque, N. Mex. (839.4 mb.)				Apalachicola, Fla. (1,014.4 mb.)				Atlanta, Ga. (982.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	86	18.9	83	31	1,620	25.3	40	21	5	25.6	88	31	300	23.5	81
1,000	31	125	20.3	77	31	44	(*)	----	21	131	25.2	87	31	142	(*)	----
950	31	573	19.8	67	31	518	(*)	----	21	585	22.8	85	31	595	23.8	68
900	31	1,034	16.9	66	31	1,004	(*)	----	21	1,053	20.2	82	31	1,064	20.8	68
850	31	1,519	13.5	67	31	1,510	(*)	----	21	1,546	17.2	82	31	1,556	17.2	71
800	31	2,026	9.9	66	31	2,042	23.7	35	21	2,062	14.3	77	31	2,072	13.8	70
750	31	2,565	6.4	67	31	2,605	19.6	39	21	2,607	11.4	73	31	2,615	10.8	64
700	31	3,122	2.8	60	31	3,190	14.6	45	21	3,180	8.5	70	31	3,186	7.5	56
650	31	3,720	.0	49	31	3,812	9.3	54	21	3,790	5.0	71	31	3,798	4.3	52
600	31	4,356	−3.5	43	31	4,469	3.7	65	21	4,439	1.3	67	31	4,441	.9	46
550	31	5,038	−7.5	40	30	5,168	−1.8	73	21	5,133	−2.6	64	31	5,137	−2.9	42
500	31	5,774	−12.2	----	30	5,920	−6.9	68	21	5,885	−6.8	----	31	5,885	−7.4	40
450	30	6,581	−17.6	----	30	6,746	−11.3	54	21	6,709	−11.9	----	31	6,706	−12.2	42
400	30	7,444	−23.8	----	30	7,631	−16.8	48	21	7,592	−17.8	----	31	7,589	−18.4	41
350	30	8,404	−31.2	----	30	8,619	−23.8	----	20	8,581	−24.3	----	31	8,571	−25.7	----
300	30	9,479	−39.2	----	30	9,726	−32.3	----	20	9,686	−32.6	----	31	9,668	−34.2	----
250	30	10,703	−48.3	----	30	10,985	−42.1	----	20	10,944	−42.4	----	30	10,918	−43.7	----
200	29	12,147	−54.5	----	30	12,457	−53.3	----	20	12,411	−54.5	----	30	12,382	−54.2	----
175	29	12,908	−56.4	----	29	13,304	−59.4	----	20	13,253	−60.9	----	30	13,226	−59.6	----
150	28	13,973	−59.1	----	28	14,256	−65.0	----	20	14,196	−67.0	----	27	14,171	−64.1	----
125	24	15,113	−60.9	----	18	15,347	−69.4	----	18	15,280	−72.4	----	22	15,274	−68.2	----
100	23	16,503	−61.5	----	6	16,698	−65.4	----	11	16,574	−71.7	----	10	16,604	−66.3	----
80	20	17,892	−58.1	----	----	----	----	----	6	17,906	−66.7	----	----	----	----	----
60	15	19,712	−55.3	----	----	----	----	----	----	----	----	----	----	----	----	----
50	10	20,884	−54.4	----	----	----	----	----	----	----	----	----	----	----	----	----
40	5	22,311	−52.4	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Big Spring, Tex. (926.4 mb.)				Bismarck, N. Dak. (954.2 mb.)				Boise, Idaho (912.8 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	774	28.5	43	30	505	21.3	65	31	868	23.4	36
1,000	31	87	(*)	----	30	93	(*)	----	31	60	(*)	----
950	31	549	(*)	----	30	545	(*)	----	31	520	(*)	----
900	31	1,031	28.2	38	30	1,013	21.3	50	31	992	25.5	26
850	31	1,536	24.5	42	30	1,505	18.1	51	31	1,491	22.5	25
800	31	2,063	20.0	48	30	2,021	14.8	51	31	2,013	18.1	28
750	31	2,615	15.3	55	30	2,570	10.8	55	31	2,566	13.4	32
700	31	3,197	10.9	55	30	3,136	6.8	52	31	3,136	8.7	35
650	31	3,813	6.7	50	30	3,740	3.3	46	31	3,748	3.8	38
600	31	4,464	2.6	48	30	4,385	−1.2	44	31	4,388	−1.1	41
550	31	5,167	−1.5	44	30	5,073	−5.9	42	31	5,075	−6.4	43
500	31	5,916	−5.9	39	30	5,813	−11.0	41	31	5,814	−11.9	41
450	30	6,746	−10.7	----	29	6,620	−16.7	43	31	6,615	−17.6	----
400	30	7,631	−16.5	----	28	7,490	−22.7	----	31	7,484	−24.0	----
350	30	8,621	−23.4	----	27	8,455	−29.8	----	31	8,443	−31.2	----
300	29	9,729	−31.8	----	27	9,534	−38.2	----	31	9,516	−39.7	----
250	29	10,992	−41.4	----	27	10,765	−47.0	----	31	10,739	−48.1	----
200	29	12,460	−52.7	----	27	12,215	−54.5	----	31	12,188	−53.9	----
175	29	13,319	−58.3	----	26	13,065	−56.1	----	31	13,041	−56.0	----
150	25	14,270	−64.1	----	25	14,038	−58.1	----	30	14,012	−58.1	----
125	21	15,308	−69.4	----	21	15,178	−60.0	----	30	15,154	−59.9	----
100	5	16,714	−69.8	----	17	16,565	−59.9	----	25	16,546	−60.9	----
80	----	----	----	----	13	17,953	−57.2	----	15	17,957	−58.5	----
60	----	----	----	----	6	19,797	−53.2	----	13	19,776	−56.2	----
50	----	----	----	----	----	----	----	----	6	20,932	−54.8	----
40	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Brownsville, Tex. (1,011.6 mb.)				Buffalo, N. Y. (990.2 mb.)				Camaguey, Cuba (1,002.0 mb.)				Caribou, Maine (990.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	6	27.4	82	31	221	19.7	77	25	122	24.5	92	31	191	16.0	84
1,000	31	109	26.9	81	31	135	(*)	----	25	140	24.4	91	31	107	(*)	----
950	31	564	24.2	80	31	581	19.8	60	25	595	23.0	86	31	551	17.6	65
900	31	1,036	22.3	64	31	1,043	16.6	61	25	1,063	21.1	78	31	1,007	14.8	68
850	31	1,531	19.9	54	31	1,527	13.2	63	25	1,556	18.3	73	31	1,488	11.5	72
800	31	2,052	17.0	48	31	2,035	9.9	62	25	2,074	15.3	64	31	1,992	8.2	74
750	31	2,590	13.8	46	31	2,575	6.7	56	25	2,619	11.9	61	31	2,526	4.8	69
700	31	3,177	10.1	46	31	3,132	3.6	50	24	3,194	8.5	59	31	3,079	1.8	65
650	31	3,790	6.6	45	31	3,734	.2	45	24	3,805	4.8	56	31	3,677	−1.5	61
600	31	4,442	2.8	45	30	4,369	−3.2	43	24	4,453	1.4	53	31	4,311	−4.8	53
550	31	5,141	−1.2	46	30	5,053	−7.2	37	23	5,155	−2.6	52	31	4,992	−8.9	50
500	31	5,896	−5.6	40	30	5,789	−11.8	36	23	5,898	−7.6	56	31	5,722	−13.5	46
450	31	6,722	−10.8	39	29	6,600	−16.9	----	23	6,721	−12.5	53	31	6,522	−18.6	42
400	31	7,609	−16.8	38	29	7,467	−22.9	----	23	7,603	−18.4	55	31	7,385	−24.8	----
350	31	8,598	−23.8	----	29	8,431	−30.2	----	23	8,584	−25.6	----	31	8,341	−32.2	----
300	31	9,705	−31.9	----	28	9,510	−38.0	----	23	9,684	−34.1	----	31	9,411	−39.9	----
250	31	10,968	−41.3	----	28	10,742	−46.5	----	23	10,932	−45.0	----	30	10,628	−48.0	----
200	30	12,442	−53.3	----	28	12,200	−53.4	----	22	12,379	−57.7	----	27	12,080	−54.0	----
175	30	13,288	−59.7	----	27	13,058	−55.1	----	22	13,207	−64.6	----	23	12,923	−54.3	----
150	30	14,236	−66.2	----	21	13,997	−55.8	----	21	14,135	−70.2	----	10	13,928	−54.9	----
125	27	15,330	−72.0	----	10	15,122	−56.0	----	14	15,218	−73.7	----	----	----	----	----
100	22	16,634	−73.0	----	----	----	----	----	5	16,518	−73.6	----	----	----	----	----
80	13	17,949	−68.6	----	----	----	----	----	----	----	----	----	----	----	----	----
60	8	19,690	−62.9	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Charleston, S. C. (1,014.9 mb.)				Ciudad Victoria, Mexico (972.1 mb.)				Columbia, Mo. (987.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	13	22.9	92	27	335	29.6	57	31	239	23.6	78
1,000	31	142	24.0	87	27	81	(*)	----	31	131	(*)	----
950	31	595	23.0	71	27	542	28.0	57	31	588	24.0	64
900	31	1,063	20.2	68	27	1,018	24.3	60	31	1,053	20.8	67
850	31	1,555	17.2	66	27	1,516	20.4	63	31	1,545	17.4	67
800	31	2,070	14.2	61	27	2,037	16.5	68	31	2,061	14.4	61
750	31	2,617	11.1	59	27	2,587	12.5	71	31	2,609	11.3	52
700	31	3,186	7.7	58	27	3,160	8.9	66	31	3,178	8.0	49
650	30	3,802	4.4	59	27	3,775	5.4	61	31	[illegible]	4.3	48
600	30	4,443	1.0	55	27	4,422	1.8	58	31	[illegible]	.5	46
550	30	5,143	−2.8	47	27	5,122	−1.9	51	30	5,126	−3.6	39
500	30	5,888	−7.0	41	26	5,870	−6.1	41	30	5,873	−8.2	41
450	29	6,713	−12.3	44	26	6,700	−11.0	41	29	6,696	−13.1	40
400	29	7,594	−18.3	45	26	7,584	−16.8	42	29	7,573	−19.3	----
350	28	8,576	−25.2	----	25	8,572	−24.1	----	29	8,551	−26.8	----
300	28	9,677	−33.3	----	25	9,678	−32.6	----	29	9,645	−35.1	----
250	28	10,932	−43.1	----	25	10,936	−42.8	----	29	10,890	−44.5	----
200	28	12,398	−54.1	----	21	12,402	−54.5	----	29	12,352	−54.2	----
175	28	13,242	−59.6	----	11	13,263	−60.8	----	27	13,201	−58.9	----
150	28	14,194	−68.3	----	----	----	----	----	18	14,156	−62.9	----
125	27	15,295	−64.6	----	----	----	----	----	6	15,230	−64.6	----
100	13	16,622	−68.2	----	----	----	----	----	----	----	----	----
80	8	17,985	−64.4	----	----	----	----	----	----	----	----	----
60	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Dodge City, Kans. (925.6 mb.)				El Paso, Tex. (881.0 mb.)				Ely, Nev. (809.8 mb.)				Fort Worth, Tex. (988.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	792	22.9	68	31	1,195	29.0	33	31	1,908	20.2	27	31	211	29.7	48
1,000	31	108	(*)	----	31	47	(*)	----	31	33	(*)	----	31	110	(*)	----
950	31	566	(*)	----	31	519	(*)	----	31	502	(*)	----	31	575	29.1	47
900	31	1,038	24.9	57	31	1,009	(*)	----	31	983	(*)	----	31	1,049	25.5	51
850	31	1,537	21.7	54	31	1,514	28.1	30	31	1,483	(*)	----	31	1,550	21.6	54
800	31	2,060	18.6	49	31	2,047	23.8	33	31	2,013	22.7	22	31	2,073	17.9	57
750	31	2,614	15.0	48	31	2,608	18.9	41	31	2,574	18.8	22	31	2,625	14.2	53
700	31	3,191	10.9	50	31	3,194	13.6	48	31	3,156	13.5	25	31	3,201	10.5	49
650	31	3,807	6.6	48	31	3,813	8.3	54	31	3,777	7.8	31	31	3,820	6.4	48
600	30	4,458	2.0	47	31	4,468	3.2	55	31	4,426	1.9	40	31	4,466	2.0	49
550	30	5,155	−2.8	48	31	5,168	−1.5	55	31	5,119	−4.2	46	31	5,174	−1.5	43
500	29	5,906	−7.3	45	31	5,921	−6.4	56	31	5,864	−9.6	44	31	5,918	−5.8	40
450	29	6,727	−12.4	45	30	6,749	−11.0	40	31	6,677	−14.9	----	30	6,750	−10.5	31
400	29	7,609	−18.2	46	30	7,634	−16.8	35	30	7,551	−21.2	----	30	7,634	−16.5	32
350	29	8,593	−25.1	----	29	8,623	−23.9	----	30	8,522	−28.2	----	30	8,623	−23.8	----
300	29	9,692	−33.6	----	29	9,729	−32.2	----	29	9,612	−36.0	----	30	9,729	−32.4	----
250	29	10,944	−43.5	----	29	10,988	−42.2	----	28	10,857	−45.1	----	30	10,988	−42.3	----
200	29	12,407	−54.4	----	28	12,459	−53.9	----	28	12,315	−54.3	----	30	12,458	−53.8	----
175	27	13,249	−60.2	----	28	13,302	−60.3	----	26	13,162	−58.0	----	30	13,303	−60.0	----
150	17	14,194	−65.7	----	27	14,246	−64.7	----	22	14,126	−62.4	----	30	14,251	−66.0	----
125	12	15,282	−69.7	----	23	15,327	−72.3	----	18	15,239	−66.1	----	29	15,344	−71.5	----
100	8	16,595	−67.7	----	11	16,626	−71.9	----	14	16,590	−66.3	----	26	16,657	−72.0	----
80	----	----	----	----	5	17,974	−66.4	----	11	17,952	−62.8	----	20	17,995	−67.1	----
60	----	----	----	----	----	----	----	----	6	19,748	−58.8	----	15	19,758	−60.9	----
50	----	----	----	----	----	----	----	----	----	----	----	----	12	20,897	−58.1	----
40	----	----	----	----	----	----	----	----	----	----	----	----	6	22,308	−56.2	----

Standard pressure surface (mb.)	Glasgow, Mont. (936.6 mb.)				Grand Junction, Colo. (853.0 mb.)				Great Falls, Mont. (885.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	648	22.9	44	31	1,474	23.9	38	31	1,128	21.3	40
1,000	31	68	(*)	----	31	52	(*)	----	31	61	(*)	----
950	31	526	(*)	----	31	523	(*)	----	31	521	(*)	----
900	31	996	23.0	40	31	1,004	(*)	----	31	995	(*)	----
850	31	1,491	19.6	40	31	1,505	24.6	37	31	1,486	20.0	37
800	31	2,009	15.7	43	31	2,035	22.6	32	31	2,005	16.1	40
750	31	2,558	11.4	48	31	2,596	18.0	36	31	2,553	11.6	46
700	31	3,124	7.0	49	31	3,177	13.1	40	31	3,122	7.1	52
650	31	3,732	2.4	51	31	3,798	7.8	47	31	3,726	2.5	54
600	31	4,371	−2.1	46	31	4,449	2.2	55	31	4,368	−2.3	59
550	31	5,058	−6.7	42	31	5,145	−3.3	57	30	5,057	−7.5	58
500	31	5,794	−11.8	42	31	5,802	−8.5	53	30	5,788	−12.9	58
450	31	6,601	−17.4	38	31	6,714	−13.6	45	30	6,592	−18.8	58
400	31	7,465	−23.8	----	31	7,588	−19.3	----	29	7,451	−25.0	----
350	30	8,424	−31.2	----	31	8,567	−26.3	----	29	8,407	−32.2	----
300	30	9,497	−39.7	----	31	9,662	−34.6	----	28	9,475	−40.5	----
250	30	10,717	−49.2	----	31	10,911	−44.0	----	26	10,695	−49.4	----
200	30	12,158	−54.1	----	31	12,374	−53.9	----	22	12,142	−54.7	----
175	29	13,008	−55.2	----	30	13,221	−58.5	----	22	12,998	−55.5	----
150	29	13,988	−56.5	----	28	14,181	−63.1	----	18	13,980	−56.0	----
125	24	15,146	−57.8	----	22	15,291	−66.7	----	17	15,138	−58.0	----
100	21	16,549	−58.8	----	9	16,609	−66.8	----	7	16,511	−57.8	----
80	14	17,959	−57.3	----	5	17,980	−61.1	----	----	----	----	----
60	7	19,802	−54.7	----	----	----	----	----	----	----	----	----
50	7	20,972	−53.1	----	----	----	----	----	----	----	----	----
40	5	22,402	−51.9	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

Table 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during August 1948*—Continued

Standard pressure surface (mb.)	Greensboro, N. C. (985.6 mb.)				Hatteras, N. C. (1,016.1 mb.)				Havana, Cuba[1]				Honolulu, T. H. (1,014.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	273	21.3	90	31	3	24.7	85					31	3	28.1	63
1,000	31	146	(*)		31	143	24.2	81					31	126	26.2	65
950	31	598	23.1	70	31	596	22.0	71					31	580	22.3	73
900	31	1,066	20.2	69	31	1,061	19.3	64					31	1,045	18.8	77
850	31	1,557	16.7	70	31	1,549	16.4	61					31	1,535	16.0	77
800	31	2,071	13.2	68	31	2,064	13.4	54					31	2,049	14.2	62
750	31	2,615	9.9	64	31	2,605	10.5	51					31	2,597	12.1	45
700	31	3,182	6.5	63	31	3,177	7.1	48					31	3,167	8.7	45
650	31	3,792	2.8	59	31	3,783	3.7	46					31	3,784	5.3	46
600	30	4,433	−.3	54	31	4,429	.3	37					31	4,426	2.1	38
550	30	5,125	−3.8	47	30	5,124	−3.7	39					31	5,125	−1.3	36
500	30	5,872	−8.0	43	29	5,867	−8.0	40					31	5,879	−5.4	37
450	30	6,694	−13.4		29	6,686	−13.0	42					31	6,706	−10.6	
400	29	7,571	−19.3		29	7,566	−19.2	49					31	7,594	−16.8	
350	29	8,550	−26.2		29	8,546	−25.9						31	8,582	−24.2	
300	29	9,646	−34.4		29	9,643	−34.0						31	9,686	−32.9	
250	29	10,896	−43.7		27	10,894	−43.7						31	10,942	−43.0	
200	29	12,360	−53.9		27	12,356	−54.6						31	12,407	−54.9	
175	29	13,208	−58.3		27	13,201	−59.4						31	13,247	−61.0	
150	26	14,170	−62.4		27	14,154	−63.9						30	14,191	−66.4	
125	15	15,283	−64.9		23	15,261	−67.2						29	15,287	−68.6	
100	5	16,614	−63.8		21	16,606	−66.4						26	16,628	−68.1	
80					15	17,978	−62.2						22	17,979	−65.1	
60					9	19,777	−58.5						21	19,753	−60.0	
50													18	20,892	−56.8	
40													12	22,328	−53.6	

Standard pressure surface (mb.)	Huntington, W. Va. (996.5 mb.)				International Falls, Minn. (974.2 mb.)				Joliet, Ill. (995.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	172	19.9	84	31	360	16.8	86	31	178	20.2	78
1,000	31	141	(*)		31	135	(*)		31	140	(*)	
950	31	591	21.6	67	31	582	19.8	68	31	591	21.7	64
900	31	1,054	18.4	68	31	1,041	17.2	61	31	1,053	18.4	66
850	31	1,542	14.9	71	31	1,527	14.1	61	31	1,542	15.4	64
800	31	2,053	11.4	69	31	2,036	11.1	58	31	2,053	12.0	62
750	31	2,595	8.2	63	31	2,576	7.5	60	31	2,598	8.9	56
700	31	3,156	5.2	56	31	3,137	4.1	56	31	3,159	5.8	50
650	31	3,757	1.7	51	31	3,740	.8	48	31	3,764	2.2	51
600	30	4,400	−1.7	45	31	4,376	−3.0	47	31	4,405	−1.6	47
550	30	5,089	−5.3		31	5,062	−7.3	47	31	5,093	−5.8	40
500	28	5,832	−10.1		31	5,795	−12.2	44	31	5,833	−10.3	
450	28	6,644	−15.5		31	6,604	−17.5	41	31	6,646	−15.3	
400	28	7,517	−21.4		31	7,465	−23.8		31	7,517	−21.7	
350	28	8,488	−28.3		31	8,425	−31.1		31	8,486	−29.0	
300	28	9,575	−36.5		31	9,499	−39.4		30	9,572	−37.0	
250	27	10,810	−45.0		30	10,718	−48.6		29	10,818	−45.5	
200	26	12,270	−53.6		29	12,157	−54.3		27	12,278	−53.8	
175	24	13,130	−57.4		28	13,014	−54.3		26	13,133	−57.4	
150	23	14,087	−60.7		27	13,996	−54.9		22	14,108	−61.0	
125	17	15,202	−62.5		23	15,151	−56.0		10	15,232	−63.3	
100	10	16,564	−61.8		14	16,566	−55.6					
80	6	17,949	−58.7									
60												
50												
40												

Standard pressure surface (mb.)	Lake Charles, La. (1,013.7 mb.)				Lander, Wyo. (829.8 mb.)				Las Vegas, Nev. (942.6 mb.)				Little Rock, Ark. (1,006.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	5	26.0	85	31	1,696	21.0	33	31	574	33.3	15	31	79	25.1	82
1,000	31	126	26.7	76	31	42	(*)		31	33	(*)		31	134	25.7	77
950	31	582	25.0	66	31	510	(*)		31	506	(*)		31	591	24.7	68
900	31	1,053	22.5	64	31	988	(*)		31	991	31.9		31	1,060	21.8	68
850	31	1,548	19.3	65	31	1,486	(*)		31	1,499	27.4		31	1,554	18.8	66
800	31	2,068	16.0	61	31	2,014	22.0	29	31	2,030	22.7	21	31	2,073	15.9	58
750	31	2,618	12.6	56	31	2,574	17.8	30	31	2,588	17.7	25	31	2,622	12.9	55
700	31	3,190	9.3	50	31	3,154	12.9	35	31	3,170	12.4	29	31	3,195	9.6	51
650	31	3,804	5.8	48	31	3,771	7.4	42	31	3,788	7.0	34	31	3,813	5.8	51
600	31	4,451	1.9	44	31	4,423	1.8	48	31	4,439	2.1	37	31	4,458	1.8	52
550	31	5,148	−2.0	41	31	5,117	−4.1	53	31	5,137	−2.8	33	31	5,157	−2.1	45
500	31	5,900	−6.6	40	31	5,862	−9.8	48	31	5,884	−7.7		31	5,906	−6.4	45
450	31	6,724	−11.3	38	31	6,680	−15.4	39	31	6,705	−13.0		30	6,731	−11.4	45
400	31	7,610	−17.5		31	7,546	−21.4		31	7,584	−19.1		30	7,618	−17.2	43
350	31	8,596	−24.3		31	8,516	−28.8		31	8,563	−26.5		29	8,603	−24.4	
300	31	9,701	−32.6		31	9,600	−37.0		31	9,650	−34.8		29	9,706	−32.7	
250	31	10,958	−42.5		31	10,837	−45.8		31	10,906	−44.5		29	10,963	−42.5	
200	31	12,427	−54.4		31	12,293	−54.3		31	12,366	−54.7		29	12,434	−53.7	
175	31	13,270	−60.7		22	13,137	−57.1		29	13,211	−59.8		28	13,279	−59.1	
150	29	14,210	−66.4		14	14,099	−60.5		16	14,163	−64.4		28	14,232	−64.5	
125	26	15,303	−71.6						6	15,256	−67.7		23	15,336	−68.4	
100	20	16,625	−72.2										12	16,677	−66.8	
80	14	17,936	−68.9										7	18,058	−62.5	

Standard pressure surface (mb.)	Mazatlan, Mexico (1,007.5 mb.)				Medford, Oreg. (967.2 mb.)				Merida, Mexico (1,010.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	14	29.2	75	31	401	23.5	42	31	27	27.0	79
1,000	31	81	28.7	76	31	107	(*)		31	122	26.2	79
950	31	542	25.2	79	31	563	22.6	42	31	574	24.4	74
900	31	1,012	22.6	77	31	1,025	19.0	47	31	1,047	21.6	73
850	31	1,508	19.9	75	31	1,512	15.0	53	31	1,542	18.4	74
800	31	2,030	17.1	69	31	2,022	11.0	59	31	2,060	15.3	72
750	31	2,588	14.3	63	31	2,564	7.4	60	31	2,609	12.3	64
700	31	3,158	10.8	61	31	3,122	4.1	49	31	3,181	9.1	60
650	31	3,777	6.5	68	31	3,723	.4	41	31	3,795	5.6	57
600	30	4,426	2.0	74	31	4,358	−3.8	35	31	4,443	1.9	57
550	29	5,127	−2.8	76	31	5,039	−8.2	36	31	5,137	−2.1	56
500	28	5,876	−7.1	67	30	5,772	−13.2	38	31	5,892	−6.6	57
450	27	6,703	−11.5	54	29	6,571	−18.8	42	31	6,714	−11.6	57
400	27	7,587	−17.0	53	29	7,432	−25.4		31	7,602	−17.5	65
350	26	8,574	−24.2		29	8,387	−32.7		30	8,588	−24.6	
300	26	9,679	−32.5		29	9,454	−40.6		30	9,691	−33.2	
250	25	10,937	−42.5		28	10,677	−48.9		29	10,943	−43.7	
200	12	12,415	−54.0		28	12,120	−54.4		23	12,402	−56.4	
175					28	12,973	−55.6		19	13,237	−63.4	
150					27	13,953	−56.9		10	14,191	−70.0	
125					24	15,098	−58.6					
100					19	16,505	−59.6					
80					16	17,906	−58.2					

Standard pressure surface (mb.)	Miami, Fla. (1,015.7 mb.)				Nantucket, Mass. (1,014.2 mb.)				Nashville, Tenn. (995.5 mb.)				New Orleans, La. (1,014.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	4	26.2	84	26	14	19.1	93	31	177	25.0	66	30	2	25.4	87
1,000	31	142	25.9	82	26	136	20.5	86	31	137	(*)		30	129	26.4	80
950	31	597	23.3	82	26	584	20.3	69	31	593	24.3	58	30	585	24.8	71
900	31	1,066	20.6	77	26	1,046	17.7	61	31	1,060	20.7	63	30	1,057	22.0	67
850	31	1,558	17.7	73	26	1,533	14.8	61	31	1,551	16.9	68	30	1,552	19.0	63
800	31	2,075	14.8	69	26	2,043	11.9	59	31	2,066	13.4	65	30	2,071	15.8	62
750	31	2,621	11.8	64	26	2,589	8.9	58	31	2,615	10.3	56	30	2,621	12.6	60
700	31	3,194	8.5	66	26	3,149	6.0	52	31	3,178	7.4	51	30	3,193	9.4	57
650	31	3,807	4.9	69	26	3,751	2.5	52	30	3,791	4.0	46	29	3,808	6.0	51
600	31	4,453	1.1	70	25	4,397	−.9	47	30	4,430	.8	38	29	4,456	2.3	49
550	31	5,149	−2.8	66	25	5,084	−4.7		30	5,126	−3.0	34	29	5,157	−1.8	46
500	31	5,898	−7.0	62	25	5,829	−9.3		30	5,873	−7.6		29	5,907	−6.2	46
450	31	6,722	−12.0	62	25	6,641	−14.8		29	6,696	−12.8		29	6,733	−11.2	40
400	31	7,606	−17.7	61	25	7,517	−20.7		28	7,574	−18.8		29	7,619	−16.9	42
350	31	8,591	−24.5		25	8,491	−27.7		28	8,555	−25.9		28	8,607	−23.8	
300	31	9,695	−32.9		25	9,580	−35.8		28	9,653	−34.1		28	9,714	−32.0	
250	31	10,951	−42.8		25	10,821	−45.1		27	10,903	−43.3		27	10,974	−41.9	
200	30	12,419	−54.8		25	12,280	−54.4		25	12,376	−53.3		27	12,447	−53.5	
175	27	13,260	−61.6		25	13,129	−57.4		22	13,226	58.3		27	13,293	−59.7	
150	26	14,202	−67.3		25	14,097	−60.0		18	14,178	−62.5		27	14,242	−65.8	
125	20	15,302	−71.3		22	15,227	−62.5		14	15,288	−65.2		25	15,336	−70.2	
100	12	16,626	−71.3		16	16,608	−61.6		7	16,634	−64.4		20	16,658	−69.1	
80	5	17,944	−67.0		13	18,000	−58.3						13	18,000	−65.3	
60					6	19,818	−55.7						5	19,752	−60.0	

Standard pressure surface (mb.)	North Platte, Nebr. (917.7 mb.)				Oakland, Calif. (1,013.3 mb.)				Ogden, Utah (863.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	849	21.8	69	31	6	16.5	79	31	1,355	23.7	37
1,000	31	91	(*)		31	118	15.5	79	31	41	(*)	
950	31	548	(*)		31	563	17.5	59	31	511	(*)	
900	31	1,019	23.6	59	31	1,019	19.3	30	31	993	(*)	
850	31	1,518	21.3	54	31	1,509	17.9	22	31	1,491	25.3	28
800	31	2,040	17.7	56	31	2,024	15.4		31	2,020	21.7	26
750	31	2,594	14.2	56	31	2,575	12.6		31	2,581	17.2	27
700	31	3,169	10.2	54	31	3,143	9.1		31	3,157	12.2	31
650	31	3,785	5.6	54	31	3,753	5.4		31	3,775	6.8	39
600	31	4,431	.9	55	31	4,401	1.0		31	4,424	1.2	44
550	31	5,126	−4.1	57	31	5,095	−3.6		31	5,115	−4.7	52
500	31	5,870	−9.2	50	31	5,840	−8.8		31	5,859	−10.5	50
450	31	6,690	−14.4		31	6,655	−14.7		31	6,674	−15.8	
400	31	7,560	−20.5		31	7,530	−21.5		31	7,542	−21.6	
350	30	8,535	−27.3		31	8,499	−29.0		31	8,511	−28.8	
300	30	9,627	−35.4		31	9,583	−37.1		31	9,596	−36.9	
250	30	10,871	−44.9		31	10,822	−45.3		31	10,835	−45.8	
200	29	12,330	−54.6		31	12,282	−53.5		29	12,280	−54.2	
175	29	13,175	−59.1		31	13,134	−56.8		29	13,136	−57.9	
150	28	14,133	−63.6		31	14,103	−59.7		24	14,103	−61.3	
125	20	15,248	−67.3		30	15,233	−62.5		20	15,227	−64.6	
100	18	16,588	−66.7		23	16,598	−62.6		11	16,579	−64.6	
80	14	17,961	−62.5		12	17,973	−60.7					
60	11	19,756	−58.2									

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during August 1948*—Continued

Standard pressure surface (mb.)	Oklahoma City, Okla. (969.3 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Omaha, Nebr. (978.7 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Phoenix, Ariz. (969.2 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Pittsburgh, Pa. (972.7 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Portland, Maine (1,012.0 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Rapid City, S. Dak. (902.8 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	St. Cloud, Minn. (977.8 mb.) Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	391	25.6	70	31	308	24.7	71	30	339	34.1	33	30	382	20.7	70	31	20	18.3	83	30	980	19.9	63	31	317	19.4	82
1,000	31	114	(*)	----	31	119	(*)	----	30	54	(*)	----	30	140	(*)	----	31	122	19.9	78	30	81	(*)	----	31	121	(*)	----
950	31	569	27.2	59	31	572	24.3	61	30	526	34.8	28	30	591	20.9	64	31	571	19.0	67	30	537	(*)	----	31	575	21.6	63
900	31	1,047	24.9	56	31	1,042	21.8	59	30	1,009	31.2	30	30	1,053	18.2	64	31	1,028	16.0	68	30	1,006	(*)	----	31	1,035	19.1	59
850	31	1,546	21.6	56	31	1,536	18.6	61	30	1,518	26.9	34	30	1,540	14.6	67	31	1,511	12.4	72	30	1,504	21.9	43	31	1,524	16.1	58
800	31	2,069	18.3	54	31	2,064	15.7	57	30	2,050	22.3	40	30	2,050	11.1	69	31	2,018	9.7	66	30	2,027	18.7	41	31	2,037	12.9	55
750	31	2,618	14.8	53	31	2,603	12.6	49	30	2,611	17.6	45	30	2,594	7.7	62	31	2,556	6.3	64	30	2,580	14.7	42	31	2,581	9.4	54
700	31	3,200	11.0	51	31	3,175	8.7	47	30	3,192	12.6	49	30	3,151	4.4	57	31	3,114	3.4	58	30	3,157	10.5	44	31	3,145	6.4	50
650	31	3,813	6.9	49	31	3,787	4.6	50	30	3,813	7.8	50	30	3,756	.9	53	31	3,711	−.2	57	30	3,709	6.0	45	31	3,752	3.0	47
600	31	4,468	2.6	48	31	4,432	.2	47	29	4,463	2.9	51	30	4,391	−2.4	43	31	4,348	−3.7	53	30	4,420	.9	50	31	4,393	−1.2	45
550	31	5,166	−1.9	49	31	5,130	−4.4	42	29	5,167	−1.8	49	30	5,081	−6.1	37	31	5,029	−7.4	47	30	5,110	−4.4	54	31	5,083	−5.3	38
500	28	5,918	−6.4	40	31	5,869	−9.0	40	29	5,915	−6.3	46	30	5,816	−10.9	----	30	5,766	−12.1	43	30	5,857	−9.7	52	31	5,824	−10.0	36
450	28	6,741	−11.2	33	31	6,688	−14.3	34	29	6,747	−11.3	41	30	6,626	−16.1	----	30	6,570	−17.4	44	30	6,670	−14.8	40	31	6,637	−15.4	38
400	28	7,629	−17.1	----	31	7,561	−20.5	----	29	7,628	−17.1	41	30	7,495	−22.2	----	30	7,437	−23.6	----	30	7,546	−21.1	----	31	7,509	−21.6	----
350	25	8,617	−24.0	----	31	8,533	−27.5	----	29	8,615	−24.6	----	30	8,464	−28.8	----	30	8,398	−30.8	----	30	8,518	−28.3	----	31	8,477	−29.1	----
300	24	9,722	−32.3	----	30	9,623	−35.8	----	29	9,718	−33.2	----	29	9,550	−37.1	----	30	9,474	−38.7	----	30	9,604	−36.7	----	31	9,550	−37.5	----
250	23	10,982	−41.8	----	30	10,866	−45.0	----	28	10,973	−43.2	----	28	10,779	−46.2	----	30	10,702	−47.6	----	30	10,843	−45.7	----	30	10,788	−46.5	----
200	21	12,460	−52.2	----	30	12,325	−54.6	----	28	12,440	−54.6	----	28	12,234	−53.9	----	29	12,149	−54.3	----	30	12,300	−53.8	----	27	12,239	−53.0	----
175	19	13,307	−58.4	----	28	13,170	−58.6	----	25	13,283	−61.0	----	28	13,085	−56.6	----	28	12,999	−56.4	----	29	13,151	−57.1	----	25	13,088	−55.0	----
150	18	14,265	−63.5	----	27	14,131	−62.2	----	13	14,221	−67.0	----	28	14,056	−59.1	----	26	13,965	−58.0	----	28	14,120	−60.5	----	18	14,078	−57.1	----
125	11	15,367	−67.1	----	24	15,249	−65.5	----	----	----	----	----	27	15,192	−61.8	----	24	15,103	−58.8	----	22	15,254	−63.2	----	----	----	----	----
100	6	16,714	−68.0	----	24	16,601	−65.3	----	----	----	----	----	23	16,581	−62.0	----	22	16,499	−59.2	----	16	16,620	−62.9	----	----	----	----	----
80	----	----	----	----	18	17,978	−62.3	----	----	----	----	----	17	17,956	−58.6	----	16	17,896	−57.0	----	13	18,001	−59.2	----	----	----	----	----
60	----	----	----	----	12	19,773	−59.1	----	----	----	----	----	11	19,780	−54.7	----	10	19,735	−54.7	----	8	19,822	−55.8	----	----	----	----	----
50	----	----	----	----	----	----	----	----	----	----	----	----	6	20,917	−54.4	----	9	20,899	−53.6	----	----	----	----	----	----	----	----	----
40	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	22,331	−52.3	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	San Antonio, Tex. (984.5 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	San Juan, P. R. (1,014.3 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Santa Maria, Calif. (1,005.5 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Sault Ste. Marie, Mich. (989.8 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Spokane, Wash. (930.3 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Swan Island, W. I. (1,012.5 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Tacubaya, Mexico (774.7 mb.) Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	240	29.8	53	31	15	26.6	83	31	71	15.1	84	31	221	15.8	85	31	721	21.3	42	31	10	27.1	82	30	2,306	16.6	72
1,000	31	100	(*)	----	31	140	25.9	83	31	118	14.5	86	31	132	(*)	----	31	89	(*)	----	31	120	26.9	80	30	67	(*)	----
950	31	565	28.4	53	31	595	22.8	85	31	562	15.9	75	31	577	17.7	69	31	540	(*)	----	31	581	23.4	82	30	532	(*)	----
900	31	1,038	25.0	56	31	1,062	19.9	83	31	1,017	21.5	29	31	1,034	15.5	66	31	1,007	19.4	42	31	1,044	20.8	74	30	1,008	(*)	----
850	31	1,537	21.4	59	31	1,554	17.0	78	31	1,511	20.2	25	31	1,517	12.4	68	31	1,495	15.2	48	31	1,537	18.3	65	30	1,503	(*)	----
800	31	2,060	17.5	60	31	2,070	14.9	62	31	2,038	17.4	25	31	2,023	9.3	66	31	2,005	11.0	54	31	2,055	15.7	54	30	2,031	(*)	----
750	31	2,611	13.9	57	31	2,619	12.3	50	31	2,584	14.1	----	31	2,557	6.1	60	31	2,542	6.8	59	31	2,607	12.7	47	30	2,583	14.6	72
700	31	3,187	10.3	51	31	3,190	8.8	48	31	3,156	10.9	----	31	3,119	2.9	54	31	3,103	2.9	60	31	3,178	9.4	47	30	3,161	10.2	78
650	31	3,801	6.8	45	31	3,801	5.2	45	31	3,772	7.2	----	31	3,720	−.2	48	31	3,699	−1.0	54	31	3,796	5.7	49	30	3,777	5.7	84
600	31	4,453	3.1	40	30	4,449	1.4	41	31	4,422	3.0	----	31	4,352	−3.7	41	31	4,335	−5.0	46	30	4,420	1.9	47	30	4,426	1.2	89
550	31	5,160	−.7	38	30	5,146	−2.4	38	31	5,120	−1.7	----	31	5,035	−8.0	40	31	5,011	−9.6	48	30	5,146	−1.9	46	30	5,126	−3.1	90
500	31	5,909	−5.2	35	30	5,896	−6.4	37	31	5,871	−6.9	----	30	5,760	−12.6	43	31	5,743	−14.1	44	30	5,892	−6.4	44	29	5,872	−6.9	71
450	31	6,742	−10.0	----	30	6,720	−11.5	34	31	6,693	−12.7	----	30	6,575	−18.1	41	31	6,537	−19.6	44	30	6,723	−11.3	42	28	6,699	−11.3	58
400	31	7,627	−16.3	----	30	7,606	−17.5	32	31	7,572	−19.3	----	30	7,436	−24.6	----	30	7,396	−26.0	----	30	7,604	−16.9	40	28	7,583	−17.2	59
350	31	8,618	−23.4	----	30	8,591	−24.8	----	31	8,519	−26.4	----	30	8,394	−31.9	----	30	8,347	−33.4	----	30	8,591	−24.2	----	27	8,569	−24.4	----
300	31	9,726	−31.7	----	30	9,693	−33.4	----	31	9,646	−34.6	----	30	9,466	−40.0	----	30	9,410	−41.7	----	30	9,695	−32.6	----	27	9,672	−33.1	----
250	31	10,992	−41.0	----	30	10,947	−43.4	----	31	10,896	−43.6	----	29	10,689	−48.2	----	30	10,622	−50.3	----	30	10,953	−42.6	----	25	10,924	−43.6	----
200	31	12,472	−52.4	----	30	12,409	−55.2	----	30	12,362	−53.3	----	26	12,142	−53.3	----	30	12,061	−53.7	----	30	12,418	−54.8	----	24	12,384	−56.0	----
175	31	13,322	−58.6	----	29	13,250	−61.4	----	29	13,211	−58.1	----	25	13,002	−54.6	----	30	12,920	−53.3	----	30	13,258	−61.7	----	16	13,216	−62.8	----
150	28	14,276	−64.6	----	29	14,192	−67.3	----	25	14,166	−62.4	----	19	13,997	−55.6	----	29	13,909	−54.2	----	29	14,196	−68.3	----	7	14,142	−70.4	----
125	25	15,374	−70.0	----	27	15,273	−71.5	----	22	15,282	−66.1	----	8	15,118	−56.0	----	28	15,076	−55.5	----	21	15,283	−73.8	----	----	----	----	----
100	7	16,720	−69.7	----	20	16,591	−72.4	----	17	16,627	−66.8	----	----	----	----	----	25	16,500	−56.2	----	10	16,584	−74.1	----	----	----	----	----
80	----	----	----	----	8	17,931	−68.4	----	11	17,995	−63.8	----	----	----	----	----	19	17,926	−55.6	----	----	----	----	----	----	----	----	----
60	----	----	----	----	----	----	----	----	5	19,800	−57.9	----	----	----	----	----	14	19,768	−53.4	----	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	7	20,976	−52.1	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Tampa, Fla. (1,015.4 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Tatoosh Island, Wash. (1,013.2 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Toledo, Ohio (993.9 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Washington, D. C. (1,013.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	9	25.3	87	31	31	13.2	94	31	191	19.7	79	31	25	22.5	83
1,000	28	144	25.6	85	31	141	12.6	92	31	138	(*)	----	31	143	23.0	76
950	28	597	22.4	84	31	580	11.6	85	31	585	21.3	55	31	592	21.5	65
900	28	1,064	19.7	80	31	1,023	10.3	77	31	1,050	17.9	58	31	1,068	18.6	64
850	28	1,556	16.8	77	31	1,498	8.5	71	31	1,537	14.2	61	31	1,546	15.5	60
800	28	2,071	13.8	75	31	1,997	6.0	68	31	2,046	10.8	57	31	2,058	12.2	60
750	28	2,614	10.8	71	31	2,534	3.5	58	31	2,586	8.0	50	31	2,599	8.8	56
700	28	3,185	7.5	70	31	3,081	.6	54	31	3,148	5.1	44	31	3,164	5.2	57
650	28	3,796	4.1	67	30	3,679	−2.8	49	31	3,753	1.8	40	30	3,769	2.0	53
600	28	4,440	.5	66	30	4,304	−6.4	54	31	4,392	−2.0	38	30	4,410	−1.7	49
550	28	5,132	−3.3	66	30	4,984	−10.4	46	31	5,078	−5.9	35	30	5,096	−5.9	46
500	28	5,883	−7.4	62	30	5,707	−15.2	45	31	5,819	−10.5	----	30	5,838	−10.3	42
450	28	6,704	−12.2	59	30	6,502	−20.6	----	30	6,631	−16.1	----	30	6,646	−15.2	----
400	28	7,589	−17.8	59	30	7,357	−27.0	----	30	7,500	−22.6	----	30	7,523	−21.2	----
350	27	8,576	−24.5	----	30	8,305	−34.3	----	30	8,467	−29.5	----	30	8,494	−28.2	----
300	26	9,680	−32.6	----	30	9,365	−42.2	----	30	9,548	−37.6	----	29	9,575	−36.5	----
250	26	10,937	−42.5	----	30	10,577	−49.0	----	30	10,783	−46.5	----	29	10,813	−45.9	----
200	26	12,403	−54.5	----	29	12,030	−51.2	----	30	12,238	−54.1	----	24	12,275	−54.3	----
175	25	13,243	−60.7	----	29	12,898	−50.9	----	30	13,088	−57.0	----	23	13,122	−57.9	----
150	24	14,185	−66.5	----	26	13,895	−51.2	----	27	14,052	−59.6	----	17	14,071	−60.3	----
125	16	15,274	−70.6	----	25	15,074	−51.7	----	20	15,167	−60.5	----	9	15,219	−64.3	----
100	7	16,612	−71.3	----	22	16,522	−52.1	----	17	16,543	−60.6	----	----	----	----	----
80	----	----	----	----	19	17,963	−51.8	----	8	17,907	−57.7	----	----	----	----	----
60	----	----	----	----	14	19,853	−50.6	----	5	19,742	−54.3	----	----	----	----	----
50	----	----	----	----	8	21,070	−49.1	----	----	----	----	----	----	----	----	----

[1] Data not yet received.

(*) Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad Victoria, Mazatlan, and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C.

All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T., during August 1948. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	125	1.8	31	276	2.3	31	44	0.7	31	198	1.3	30	128	0.5	31	328	3.5	31	108	5.4
500							31	53	.9										31	117	6.5
1,000	31	128	3.3				31	81	.8				29	140	3.5	31	327	3.5	31	123	4.2
1,500	31	124	3.3				30	79	.5	31	222	2.4	29	184	3.3	31	309	2.7	30	119	2.1
2,000	30	137	3.0	31	270	2.8	25	341	.8	31	228	3.2	29	180	2.7	31	268	2.5	28	90	1.4
2,500	30	145	2.9	31	270	2.4	24	328	1.2	31	230	4.0	27	175	1.8	31	239	3.6	28	80	1.8
3,000	30	141	2.6	31	265	2.2	21	329	1.8	30	240	4.7	25	246	4.1	31	231	6.4	27	74	1.1
4,000	27	151	.7	31	254	2.3	19	336	2.4	27	245	10.1	23	278	7.4	31	229	9.7	26	79	1.6
5,000	22	299	2.2	30	259	3.1	15	309	4.5	24	251	13.6	21	270	6.6	31	230	12.9	21	112	2.6
6,000	19	330	2.4	30	242	2.9	14	316	4.4	22	246	15.3	17	273	7.7	26	226	15.8	21	91	1.9
8,000	16	344	4.6	27	244	5.1				16	249	18.6	12	245	13.8	14	242	18.9	18	84	5.2
10,000	12	353	5.6	25	248	8.2				11	264	22.0							16	83	5.2
12,000				20	253	10.9													14	96	4.0
14,000				15	257	11.4													12	53	4.2
16,000																					

Altitude (meters) m. s. l.	Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	258	2.7	29	281	1.3	30	132	2.8	31	313	1.3	31	99	0.8	31	180	1.6
500	30	268	3.8	29	267	2.7	30	138	3.8	31	322	1.4						
1,000	30	270	4.1	29	275	4.0	30	147	1.7	30	322	1.4						
1,500	27	280	4.3	28	277	5.9	28	169	.6	30	336	1.4				31	179	2.0
2,000	25	281	5.0	27	275	6.9	25	12	.6	26	310	1.5	31	73	.6	31	167	1.8
2,500	18	285	6.6	23	287	7.3	25	342	.5	25	300	1.4	31	84	.8	31	127	1.6
3,000	16	297	7.4	20	288	7.8	22	317	.9	19	321	2.4	31	88	.8	31	116	1.6
4,000	11	295	9.2	14	300	9.3	20	293	2.3	14	319	4.4	30	255	2.1	31	94	2.2
5,000				12	306	9.4	17	295	3.2	10	317	8.3	29	253	5.8	29	112	2.3
6,000							14	300	2.4				18	253	8.6	28	180	.8
8,000													15	254	13.2	25	170	2.2
10,000																17	171	3.4
12,000																16	182	3.3
14,000																13	184	1.1
16,000																10	133	2.2

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (575 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	215	5.5	31	254	0.9	30	155	0.2	31	246	2.7	30	90	2.8	31	210	0.7	31	189	3.2
500							30	183	.6				30	106	3.3	31	241	.8			
1,000							30	235	.5	31	244	3.3	30	122	2.2	31	250	1.3	31	193	5.2
1,500				31	265	1.0	29	286	1.2	31	244	3.9	28	114	1.2	31	263	2.3	31	193	5.7
2,000	31	214	5.6	31	255	1.6	29	282	2.1	31	238	4.4	23	70	.7	29	286	2.8	31	197	6.4
2,500	31	208	6.3	31	265	2.8	28	286	2.4	31	235	5.5	23	24	.6	25	304	3.7	31	204	7.9
3,000	30	210	6.5	31	262	3.6	28	290	3.1	27	240	7.8	19	349	1.3	25	302	4.8	31	209	8.4
4,000	30	212	7.2	29	244	5.5	24	299	4.8	21	249	11.5	10	69	4.1	20	301	8.5	31	217	9.8
5,000	27	222	10.1	28	247	7.8	22	286	6.7	18	253	13.7				14	310	8.8	31	225	9.5
6,000	24	227	13.1	23	254	8.2	18	293	8.9	11	248	17.7							31	223	9.0
8,000	22	233	17.9	18	255	13.8													29	233	14.5
10,000	18	239	23.0	13	259	17.0													24	232	21.0
12,000	11	254	23.7	11	265	17.1													18	239	25.1
14,000																			13	250	22.1

Altitude (meters) m. s. l.	Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	74	2.3	31	311	3.0	31	135	3.6	28	133	1.0	31	42	1.5	29	220	1.2
500	30	71	2.4	31	310	3.0	31	145	4.2	28	140	1.1	31	45	1.7	29	258	2.1
1,000	29	65	1.3	31	307	2.5	31	165	3.0	27	49	1.4	31	50	1.4	29	286	2.7
1,500	25	358	2.1	31	270	1.7	29	184	1.7	25	31	1.6	30	16	1.1	28	301	4.1
2,000	23	18	2.9	30	225	3.3	29	198	1.1	18	27	1.8	28	6	1.5	28	297	4.8
2,500	22	33	5.3	30	213	5.1	29	187	1.1	15	354	2.4	24	3	1.7	25	292	6.4
3,000	18	38	6.2	30	222	6.1	27	201	.7	15	323	2.0	20	10	2.6	20	293	6.8
4,000	18	33	5.9	30	230	8.5	25	189	.9	11	317	2.4	16	24	2.7	11	288	6.5
5,000	13	22	7.5	27	231	9.7	22	177	1.2				16	15	3.1			
6,000				24	238	12.2	19	185	2.1				12	357	4.4			
8,000				20	235	16.2	10	145	.2									
10,000																		
12,000																		
14,000																		

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Louis, Mo. (181 m.)			St. Cloud, Minn. (318 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	278	5.2	31	144	2.6	31	168	2.4	31	222	0.6	31	125	2.3	31	313	0.5	30	196	1.8
500	31	284	4.6	31	144	3.0	31	169	3.3	31	253	.9				31	328	.9	30	190	2.6
1,000	30	278	3.0	31	150	3.4	30	188	4.0	31	253	2.0	31	123	2.3	31	311	.5	30	202	3.4
1,500	30	258	2.5	31	174	2.9	30	211	4.2	31	225	2.3	31	130	1.7	31	296	.8	29	222	4.9
2,000	30	242	2.7	29	201	2.3	29	224	5.2	31	225	2.9	30	180	1.9	30	293	1.5	28	235	5.4
2,500	30	228	3.2	25	227	2.7	26	246	5.2	31	222	3.1	30	234	2.9	24	339	3.5	24	263	6.1
3,000	30	235	3.6	23	249	3.8	24	268	5.4	31	208	3.4	27	250	5.5	22	323	3.7	24	280	6.6
4,000	30	239	6.0	22	279	5.4	22	295	6.6	29	178	3.0	25	263	9.3	20	338	5.9	17	286	7.8
5,000	30	240	8.2	20	290	5.5	21	299	7.7	27	181	4.3	22	268	11.1	16	350	6.6	16	300	12.0
6,000	30	239	10.5	14	309	7.6	20	306	8.7	26	182	4.3	20	267	14.9	11	354	9.2	15	294	13.2
8,000	28	243	14.8	10	303	10.0	16	291	10.4	22	191	5.4	15	264	20.0				10	304	15.2
10,000	25	239	19.5				12	285	13.5	15	238	8.0									
12,000	17	248	25.3							11	243	13.4									
14,000																					

Altitude (meters) m. s. l.	San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	112	2.5	31	276	3.7	28	288	3.8	30	233	3.0	31	230	3.0	29	288	1.1
500	31	100	3.0	31	264	2.5	28	292	5.2	30	223	4.1				29	281	1.6
1,000	31	88	3.3	30	255	1.5	28	288	4.5	27	213	5.1	31	230	4.6	29	277	2.3
1,500	31	88	3.6	29	250	1.5	25	297	4.0	24	208	5.3	31	221	4.8	29	282	2.8
2,000	30	89	3.7	29	230	2.5	24	304	4.5	20	204	5.2	30	218	4.8	29	291	3.5
2,500	30	79	3.9	29	223	3.5	22	307	5.5	15	205	7.0	28	222	6.5	25	298	3.9
3,000	27	81	3.9	29	217	4.9	20	308	6.9	10	214	8.1	24	221	8.6	25	296	5.2
4,000	25	86	3.3	29	204	6.1	20	317	6.9	10	205	9.1	18	218	11.2	23	291	6.2
5,000	18	84	1.6	29	203	6.0	16	301	10.2				13	230	11.1	19	284	4.7
6,000	16	63	2.2	28	214	6.5	12	291	12.4				12	227	11.3	16	297	6.6
8,000	14	39	2.8	27	229	7.9										10	282	9.6
10,000				24	232	11.2												
12,000				16	239	13.2												
14,000				11	230	15.8												

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T., during August 1948. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)			Columbia, Mo. (237 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	82	0.7	31	127	3.1	31	108	1.9	31	127	3.5	31	212	1.5	31	303	0.1	31	145	1.8
500	----	----	----	----	----	----	----	----	----	31	133	8.0	31	251	4.6	30	156	2.8	31	181	2.4
1,000	----	----	----	31	131	6.4	31	152	3.8	31	132	6.4	30	277	5.2	30	145	1.3	31	211	2.0
1,500	----	----	----	31	142	7.2	31	166	3.4	31	107	3.7	30	279	6.4	31	134	1.1	31	256	1.8
2,000	31	247	1.5	31	147	5.6	31	169	2.5	31	82	3.9	30	283	6.8	31	132	.8	31	295	2.6
2,500	31	243	2.5	31	148	4.1	31	222	2.2	31	64	3.9	30	280	7.3	31	200	.8	31	309	3.1
3,000	31	251	3.0	31	139	2.3	31	271	2.9	31	56	3.4	30	278	7.8	31	228	1.2	31	327	3.9
4,000	30	270	2.5	31	16	3.5	30	263	4.5	31	61	2.9	30	269	9.7	29	246	2.6	31	333	5.1
5,000	30	299	2.1	31	5	3.9	30	281	5.6	31	52	3.8	29	260	10.4	29	259	3.1	31	330	5.7
6,000	29	281	1.8	31	354	3.3	29	300	4.1	31	62	3.9	29	262	13.0	28	274	3.9	29	326	8.2
8,000	28	251	4.4	30	331	2.9	27	290	4.3	31	55	4.6	26	262	11.6	28	266	6.9	29	308	12.0
10,000	28	246	7.6	29	316	3.6	26	264	11.8	31	62	4.6	22	255	14.3	28	260	10.6	28	306	13.7
12,000	27	257	9.3	29	331	6.4	25	271	26.0	30	71	5.3	16	276	15.7	27	263	11.2	28	310	19.3
14,000	24	248	8.8	26	334	4.2	22	267	22.2	30	72	7.3	----	----	----	25	258	8.9	21	304	18.2
16,000	----	----	----	15	4	2.9	14	276	13.5	25	81	8.7	----	----	----	19	267	5.0	----	----	----
18,000	----	----	----	----	----	----	----	----	----	13	69	6.8	----	----	----	----	----	----	----	----	----

Altitude (meters) m. s. l.	Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Miami, Fla. (12 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	138	0.4	31	187	0.6	31	201	0.7	31	172	0.7	31	76	1.1	31	124	0.8
500	----	----	----	31	190	2.1	31	227	1.9	30	198	1.4	31	92	3.1	31	151	3.0
1,000	----	----	----	31	223	1.5	31	228	1.7	30	242	2.7	31	74	2.2	31	147	2.8
1,500	31	141	.4	31	262	1.3	30	233	1.5	30	265	3.5	31	51	1.9	30	137	2.9
2,000	31	203	2.1	31	281	1.4	30	229	2.2	30	280	4.1	31	350	1.9	30	135	2.5
2,500	31	234	3.0	31	286	2.1	30	237	2.6	31	280	4.9	31	355	2.6	30	146	2.0
3,000	31	237	3.6	31	274	2.2	31	233	3.3	31	286	5.4	31	342	3.6	30	171	.8
4,000	31	239	4.3	30	266	2.7	29	227	3.8	29	287	6.7	31	330	5.4	29	186	.6
5,000	31	249	5.2	29	279	4.5	26	246	4.9	29	290	9.3	31	329	6.2	30	200	1.1
6,000	31	252	8.1	30	281	6.1	26	263	6.2	29	286	10.2	31	329	6.0	30	217	.7
8,000	30	251	13.8	29	272	9.3	25	261	9.6	26	303	12.8	30	312	6.8	30	260	2.1
10,000	29	250	18.5	28	266	12.6	22	278	12.0	23	297	17.5	29	309	9.4	31	312	2.7
12,000	23	260	21.4	27	267	16.7	18	290	12.0	19	294	21.3	26	285	13.3	30	331	5.6
14,000	18	261	16.4	19	279	9.7	13	292	8.0	14	308	20.0	24	282	10.2	25	23	4.6
16,000	----	----	----	----	----	----	----	----	----	10	305	14.6	10	337	8.5	17	96	4.4
18,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Altitude (meters) m. s. l.	Nantucket, Mass. (14 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (2 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)			San Antonio, Tex. (242 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	27	222	2.1	31	93	0.6	31	131	1.0	31	283	4.7	31	113	4.1	31	170	2.2	31	123	4.1
500	27	256	4.9	31	96	2.0	31	129	2.8	31	285	5.5	30	120	5.7	----	----	----	31	125	6.7
1,000	27	261	4.5	31	82	1.5	31	93	2.9	31	277	4.9	30	146	6.9	30	170	2.3	31	120	6.7
1,500	27	274	5.3	*31	44	1.1	31	72	3.8	31	257	3.7	30	171	4.6	29	164	3.8	31	108	4.9
2,000	26	275	5.1	31	16	1.3	31	63	4.0	31	236	3.3	30	200	3.2	29	183	2.7	30	99	3.7
2,500	26	266	5.6	31	319	1.2	30	65	3.4	31	235	3.5	31	226	2.5	28	244	3.1	30	89	3.9
3,000	26	268	7.5	31	338	3.0	30	51	2.9	31	232	4.5	31	249	2.3	28	268	5.2	30	89	4.5
4,000	26	260	8.8	31	322	4.5	29	29	3.1	31	239	5.9	31	312	2.5	29	277	9.3	29	63	4.1
5,000	25	259	10.7	30	313	5.2	29	15	3.7	31	237	8.7	31	328	4.9	28	276	11.0	30	45	4.4
6,000	25	260	12.7	29	297	7.1	29	8	2.7	31	241	11.2	28	330	5.6	26	277	13.0	30	40	4.6
8,000	24	265	15.3	28	298	11.0	28	350	4.1	31	238	16.4	27	321	8.7	24	279	15.9	30	30	4.2
10,000	19	264	18.6	26	304	13.8	28	324	3.5	30	242	23.8	24	317	11.2	22	278	22.4	29	35	3.0
12,000	----	----	----	22	289	18.7	27	292	3.9	25	239	26.7	20	305	12.5	22	275	28.6	30	19	3.3
14.000	----	----	----	----	----	----	26	322	4.1	18	244	22.3	16	312	8.2	18	274	23.4	28	31	4.5
16.000	----	----	----	----	----	----	21	7	3.1	11	240	10.9	----	----	----	12	277	10.5	18	43	6.1
18,000	----	----	----	----	----	----	11	84	6.5	----	----	----	----	----	----	----	----	----	----	----	----
20,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Altitude (meters) m. s. l.	San Juan, P. R. (28 m.)			St. Cloud, Minn. (318 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (225 m.)			Spokane, Wash. (726 m.)			Tatoosh Island, Wash. (33 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	104	4.3	31	139	0.9	31	273	3.2	31	290	1.5	31	215	2.1	31	194	3.4
500	29	101	8.8	29	164	1.9	31	324	3.1	31	301	2.8	----	----	----	28	215	3.9
1,000	29	100	9.2	29	197	2.7	31	296	4.4	31	298	3.4	31	233	3.6	29	241	3.3
1,500	29	91	9.0	30	242	2.2	31	14	2.1	30	296	4.3	31	235	4.4	29	248	3.1
2,000	29	102	8.6	30	283	2.7	31	95	1.3	30	290	4.6	31	233	5.4	31	255	3.5
2,500	29	96	9.1	30	288	4.3	31	200	.9	30	303	5.1	31	235	6.7	31	260	4.5
3,000	30	94	9.0	31	291	6.2	31	236	3.3	30	302	6.2	31	235	8.2	31	261	4.9
4,000	30	94	7.7	30	288	9.3	31	240	5.5	30	299	8.5	31	238	9.4	30	268	5.0
5,000	30	90	6.5	28	292	10.7	31	245	6.9	30	302	9.6	30	237	12.2	30	266	5.3
6,000	30	82	5.7	28	290	12.5	31	240	8.6	29	298	11.0	28	242	12.4	30	272	6.8
8,000	30	80	3.4	27	292	14.1	31	240	13.3	27	299	14.0	21	248	12.4	24	261	5.7
10,000	30	65	.6	23	294	18.2	31	239	20.4	19	291	13.7	16	238	14.0	23	229	6.0
12,000	30	256	2.0	16	285	24.7	31	242	23.1	13	301	18.7	15	240	17.5	20	239	7.8
14.000	29	161	1.3	----	----	----	17	245	18.4	----	----	----	----	----	----	19	230	6.8
16.000	23	107	4.9	----	----	----	----	----	----	----	----	----	----	----	----	17	233	4.0
18,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15	207	3.5
20,000	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10	63	1.6

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following Table III in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR AUGUST 1948

ELMER R. NELSON

River stages during August were mostly above normal in the U. S. except in the New England States, most of the Ohio Basin, and at a few other scattered points. The greatest positive departures were at Van Buren, Ark., and Swan Lake, Miss., where the river stages averaged 9.2 and 9.0 feet above normal, respectively. The greatest negative departure was at Pueblo, Colo., where the upper Arkansas averaged 2.7 feet below normal. Precipitation was very spotty, with approximately two-thirds of the country receiving deficient precipitation. The greatest precipitation (twice normal) occurred in central Virginia, southern Mississippi, and western Washington.

Serious flooding of farm lands occurred along the Spring Branch, northwest of Norfolk, Nebr., and in the lowlands east of Pierce, Nebr., during the second week of August. Excessive rains near Frankfort and Dover, Kans., caused the Black Vermillion Creek to rise to the highest stage of record and the Mission Creek to overflow a considerable amount of farm land. Moderate flooding occurred along the Blue and Republican Rivers in Nebraska and Kansas and along the lower James River in Virginia. Unusually heavy rains over the upper French Broad caused flooding at Asheville, N. C., on the 3d and 4th, with some damage to crops along bottom lands.

Atlantic Slope drainage.—Moderately heavy to heavy rains during the first 4 days of the month over the James River Basin in Virginia produced crests 3.5 to 7.7 feet above bank-full stage at and below Bremo Bluff, Va. Very little run-off resulted from the heavy rains on the 1st and 2d over the Maury (3.30 inches), Pedlar (3.01 inches), and the Rivanna (3.13 inches) sub-basins due to the dry soil conditions. The rains on the 3d and 4th were heaviest over the northern tributaries downstream from Balcony Falls, Va., averaging 3.90 inches over the Hardware River and 3.03 inches in the Tye drainage areas. Only minor damage resulted from the overflows.

Heavy rains over the headwaters of the Roanoke River on the 1st (nearly 2 inches), 3d (1.50 inches), and 4th (1.33 inches) produced rapid rises to above bank-full stages at Altavista and Randolph, Va., on the 5th and 6th. The severest flood since the summer of 1941 occurred in Roanoke, Va., due to a torrential rain on the afternoon of the 3d. More than 2 inches of rain occurred in slightly over an hour. Two deaths occurred in the western end of Giles County as a wall of water swept down the hollow between Rich Creek and Glen Lyn, washing away a summer dwelling, a sawmill, and a bridge. Several stores and basements were flooded in the low-lying areas of the business district. Several motorists were marooned, as U. S. Route 11 just east of Elliston, Va., was covered with water to a depth of 3 feet. Lowland crops along the upper Roanoke were damaged from the overflow.

Light flooding occurred in the Santee River System in South Carolina due to the heavy rains that averaged 3.72 inches in the 48-hour period ending on the 4th. No damage of consequence occurred.

Bank-full stages were exceeded on the Savannah River below Augusta, Ga., on the 6th.

East Gulf of Mexico drainage.—Minor flooding occurred on the Apalachicola River at Blountstown, Fla., during the first half of the month, due to the heavy rain from the 2d to the 5th which ranged from 2 to more than 6 inches over the upper streams. No damage resulted.

Missouri Basin.—Moderate flooding occurred along the Big Blue at Barnston, Nebr., and Randolph, Kans., on the 3d and 4th, due to heavy rain. Excessive rains of 15 or 16 inches near Frankfort, Kans., caused the Black Vermillion Creek to rise to the highest stage in its history, exceeding the crest of 1903 by several inches. The Red Willow Creek, a tributary of the Republican, exceeded bank-full stage about 8 miles east of McCook, Nebr., by 2.3 feet on the morning of the 13th. The Republican River exceeded bank-full stage twice during the month at Cambridge, Nebr.

Considerable flooding occurred at Dover, Kans., along Mission Creek due to excessive local rain (8 to 13 inches). Most of the damage resulted from the local downpours and very little from the overflowing streams. Two lives were lost on the Black Vermillion Creek.

Arkansas Basin.—Minor flooding occurred in the Arkansas River Basin between the 12th and 16th due to the heavy rains which averaged 3.70 inches, over the Caney River basin above Bartlesville, Okla., and 3 inches over the Verdigris below Coffeyville, Kans., during the 72-hour period ending at 7 a. m. on the 14th. Bank-full stage was reached on the Arkansas River at Great Bend, Ark., on the morning of the 12th. No damage resulted from the overflows.

FLOOD STAGE REPORT FOR AUGUST 1948

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE	*Feet*			*Feet*	
James:					
Bremo Bluff, Va	19	4	5	22.8	5
Columbia, Va	18	4	5	25.7	5
State Farm, Va	12	5	6	16.5	5
Richmond, Va	8	5	6	11.5	6
Roanoke:					
Altavista, Va	10	5	5	24.6	5
Randolph, Va	21	6	6	22.3	6
Saluda: Pelzer, S. C	6	4	6	8.0	5
Broad: Blairs, S. C	14	4	5	17.2	5
Catawba:					
Catawba, N. C	8	5	5	9.4	5
Catawba, S. C	11	5	5	12.0	5
EAST GULF OF MEXICO DRAINAGE					
Apalachicola: Blountstown, Fla	15	1	1	15.0	1
		5	15	18.9	8
MISSISSIPPI SYSTEM					
Missouri Basin					
Red Willow: McCook (near), Nebr	12	13	13	14.3	13
Republican: Cambridge, Nebr	5	13	13	5.6	13
		27	27	6.1	26-27
Big Blue:					
Barnston, Nebr	18	3	3	22.6	3
Randolph, Kans	22	4	4	23.1	4
Osage:					
Osceola, Mo	22	July 31	4	23.7	2
Warsaw, Mo	31	July 26	5	32.8	3
Lakeside (Bagnell Dam), Mo	60	July 17	7	61.2	1, 3, 4
Arkansas Basin					
Caney: Bartlesville, Okla	13	15	16	16.6	15
Verdigris: Inola, Okla	41.5	15	16	42.6	16
Arkansas: Great Bend, Kans	8	12	15	9.6	15

[1] Provisional.

CLIMATOLOGICAL DATA FOR AUGUST 1948

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see REVIEW, January 1943, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	° F	° F.		° F.			° F.		In.	In.		In.		In.
Alabama	79.3	−0.5	3 stations	103	[1] 30	Valley Head	52	7	3.77	−.98	Mobile Airport	11.09	Muscle Shoals	0.35
Arizona	79.7	−1.1	Yuma Valley	117	30	2 stations	32	[1] 25	2.05	−.30	Crown King	9.35	2 stations	.00
Arkansas	78.0	−2.1	Magnolia	108	13	Lead Hill	46	6	4.25	+.71	West Fork	15.16	Lake City	.67
California	70.7	−1.9	2 stations	121	30	Bora	27	5	.05	−.08	Ft. Jones	2.99	472 stations	.00
Colorado	66.0	+.3	Holyoke	105	28	Pearl	21	21	1.67	−.28	Springfield	5.85	Greeley	.15
Georgia	78.3	−1.2	Washington	105	30	Blairsville Exp. Sta	48	6	4.42	−.78	Suches	11.74	Sylvania	.97
Idaho	65.4	−.9	Grand View	104	[1] 4	4 stations	24	[1] 20	.48	−.15	Cottonwood	2.74	6 stations	.00
Illinois	74.9	+.3	Alton Dam	106	23	Freeport	42	[1] 5	1.84	−1.56	Oregon Power Plant	4.40	Illinois City Dam	.53
Indiana	73.6	−.1	Madison	103	27	Salamonia	45	6	2.01	−1.33	Mt. Vernon Water Works.	4.76	Princeton	.58
Iowa	73.9	+1.2	2 stations	104	23	Decorah	37	[1] 5	2.59	−1.18	Lake View	5.63	Iowa City	.45
Kansas	77.3	−.7	6 stations	105	[1] 17	Burr Oak	48	5	2.87	−.28	Anthony	8.75	Natoma	.28
Kentucky	75.6	−.3	Owensboro	105	25	Beaver Dam	47	6	2.17	−1.55	Brownsville Lock	5.33	Madisonville	.51
Louisiana	82.6	+.7	Winnfield	109	14	Chatham	52	2	3.87	−1.24	Tallulah	13.51	Gloster	T
Maryland-Delaware.	73.4	−.1	Glenelg, Md	107	28	Tonoloway, Md	44	6	6.13	+1.65	Leonardtown, Md	12.81	Luke, Md	2.54
Michigan	68.2	+.5	East Tawas	103	25	Watersmeet	29	5	1.71	−1.05	Hulbert	4.30	Holland Hope College	.38
Minnesota	69.4	+1.7	Winona	103	24	Meadowlands	40	[1] 4	3.43	+.14	Le Center	11.22	Morehead St. Teachers' Col.	.68
Mississippi	79.8	−1.0	Woodville	103	13	Pontotoc	54	6	4.26	+.12	Vicksburg	12.08	Corinth	.30
Missouri	76.1	−.5	3 stations	104	[1] 22	2 stations	46	6	2.15	−1.06	Pleasant Hill	6.52	Leeper	.23
Montana	66.0	+.9	Glasgow	107	18	do	25	[1] 15	.98	−.11	Lustre	4.90	Shelby	.02
Nebraska	74.7	+1.2	Nenzel	109	30	Nenzel	38	4	2.98	−.32	Pilger	6.35	Upland	.45
Nevada	69.8	−.9	Overton	114	30	Fish Creek Ranch	27	22	.16	−.33	Kyle Canyon R. S	2.88	23 stations	.00
New England	68.9	+1.8	Nashua Water Works, N. H.	105	28	Somerset, Vt	34	11	2.44	−1.29	Plymouth, N. H	6.97	Glen Cove, Maine	.06
New Jersey	73.2	+1.2	Clayton	106	26	2 stations	41	[1] 3	5.62	+.90	Chatsworth	10.87	Ringwood	2.42
New Mexico	72.6	+1.8	Jal	106	9	Gavilan	28	26	1.80	−.66	Endee	5.56	2 stations	.04
New York	69.0	+1.3	Cairo	106	26	2 stations	37	[1] 7	3.20	−.47	Schroon Lake	6.36	Wilson	.15
North Carolina	75.0	−.9	Monroe	106	29	Banners Elk	40	[1] 7	5.27	−.22	Hickory	12.05	Elizabethtown Lock	1.40
North Dakota	69.1	+2.5	Elbowoods	102	[1] 19	Sanish	36	[1] 2	1.82	−.27	Foxholm Wildlife Ref	5.06	Wildrose	.27
Ohio	72.4	+.7	Chesapeake	103	[1] 27	Norwalk	43	[1] 6	2.52	−.86	Cleveland, Shaker Hts	5.89	Montpelier	.60
Oklahoma	79.8	−1.8	Lawton	109	22	Kingfisher	50	6	3.84	+.93	Watts	12.99	Tishomingo	.00
Oregon	63.1	−2.1	Lake Creek	107	1	Chemult	26	[1] 16	.87	+.43	Seaside	3.52	3 stations	T
Pennsylvania	70.0	−.3	Marcus Hook	106	27	2 stations	34	[1] 8	3.67	−.47	Chadds Ford	7.18	Pleasant Mount	1.48
South Carolina	77.5	−1.4	Orangeburg	105	31	3 stations	51	[1] 6	4.33	−1.35	Cleveland	9.95	Orangeburg No. 2	1.18
South Dakota	72.2	+1.1	Tyndall	107	29	Ralph	37	4	1.97	−.14	Watertown	5.63	McLaughlin	.43
Tennessee	76.0	−.8	Norris	103	30	Rugby	46	6	2.12	−1.85	Tri-City	5.34	Hokenwald	T
Texas	83.8	+1.0	Henrietta	114	21	Ysleta	51	21	1.67	−.70	Freeport	7.33	15 stations	.00
Utah	69.9	0.0	Zion Nat'l Park	109	31	Woodruff	25	25	.96	−.11	Santaquin	2.62	2 stations	.00
Virginia	73.5	−.6	2 stations	103	[1] 27	Emory	44	7	6.18	+1.75	Fredericksburg	12.85	Davenport	1.44
Washington	62.6	−2.9	do	98	[1] 1	Stockdill Ranch	32	31	2.03	+1.27	Mt. Baker Lodge	13.13	Lacrosse	T
West Virginia	71.4	−.4	Charleston	105	28	Canaan Valley	39	8	3.96	−.13	Princeton	8.19	Man	1.06
Wisconsin	69.8	+2.0	La Crosse	104	24	Coddington	24	5	1.94	−1.42	Berlin Lock	5.27	Watertown	.37
Wyoming	66.3	+2.2	Red Bird	105	30	Clarkelen	18	1	.79	−.26	Yellowstone Park	2.45	Wamsutter	.01
Alaska (July)	53.4	−2.1	Circle Hot Springs	87	18	Point Hope	27	3	3.40	+.74	Whittier	17.92	Fort Yukon	.55
Hawaii	75.2	+.4	2 stations	91	[1] 18	Haleakala R. S	41	29	5.65	−.69	Iliiliula Intake	33.40	Puako	T
Puerto Rico	79.4	+.7	Aguirre	97	18	Garzas Dam	56	21	7.02	−.21	Garzas Dam	17.15	Mona Island	2.47

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS, AUGUST 1948

District and station	Elevation of instruments: Barometer above sea level[1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Greatest daily range	Total heating degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Character of day (sunrise to sunset) Number of days: Clear	Partly cloudy	Cloudy	Average cloudiness, tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
NEW ENGLAND									68.0	+2.7								81	2.42	-1.3														6.0	
Caribou[3]	628	5	33	990.5	1,013.2	-----	76	54	64.9	+3.4	86	24	45	11	31	60	56	77	3.45	+.2	1.21	9	6	.0	.0	----	s.	--	----	--	4	16	11	6.5	--
Eastport	75	67	82	1,011.2	1,015.9	+.7	71	53	61.7	+1.0	89	29	49	19	35	129	55	84	1.48	-1.5	1.15	8	5	.0	.0	6.8	s.	24	e.	6	3	19	9	5.9	66
Portland, Maine[3]	103	6	43	1,010.5	1,014.2	-1.7	81	58	69.4	+4.8	100	26	46	19	34	22	60	77	1.06	-2.1	.53	9	3	.0	.0	7.2	s.	24	s.	12	9	15	7	5.2	71
Concord[3]	289	5	45	1,004.4	1,014.9	-1.0	82	56	69.1	+3.6	100	26	42	9	38	29	60	78	1.73	-1.8	1.06	7	3	.0	.0	5.2	nw.	23	nw.	31	6	12	13	6.1	59
Mt. Washington	6,274	5	37	809.8	1,020.8	-----	54	44	48.7	+.7	66	26	31	31	18	505	46	94	5.65	-.5	1.75	17	2	.0	.0	24.4	w.	--	----	--	1	9	21	8.1	26
Burlington[3]	403	6	51	1,000.0	1,014.6	-.6	81	59	70.0	+2.1	96	26	50	10	30	18	61	78	3.41	.0	1.14	9	6	.0	.0	6.7	s.	22	s.	11	8	12	11	5.5	54
Boston[3]	124	33	62	1,010.4	1,014.8	-1.1	82	65	73.7	+3.8	100	27	58	31	25	1	62	72	1.24	-2.4	.46	7	4	.0	.0	9.6	nw.	32	sw.	12	7	15	9	5.6	68
Nantucket[3]	12	4	34	1,014.9	1,015.2	-1.1	77	62	69.3	+1.5	95	28	53	20	25	7	64	90	3.12	-.3	1.29	11	3	.0	.0	10.2	w.	28	n.	31	9	10	12	5.9	66
Block Island	26	11	46	1,013.9	1,014.9	-1.4	77	64	70.8	+2.3	95	27	59	8	23	0	65	88	.98	-2.7	.32	7	1	.0	.0	11.2	sw.	30	n.	31	8	9	14	5.9	63
Providence[3]	159	65	60	1,009.1	1,015.2	-1.1	84	64	74.3	+3.3	102	26	57	18	27	0	62	79	2.15	-1.4	1.69	4	2	.0	.0	6.5	w.	30	sw.	12	8	12	11	5.6	69
Hartford[3]	159	5	44	1,009.5	1,015.2	-1.1	83	61	71.8	+2.9	99	26	49	10	32	7	64	78	2.63	-1.7	1.06	6	1	.0	.0	6.1	s.	27	sw.	12	5	13	13	6.1	68
New Haven[3]	107	5	39	1,011.2	1,015.2	-1.1	81	63	71.8	+3.2	100	27	49	8	27	5	64	78	2.20	-1.8	1.66	9	2	.0	.0	5.6	sw.	23	e.	5	8	9	14	5.8	61
MIDDLE ATLANTIC									74.5	+.8								79	5.25	+.9														5.5	
Albany[3]	97	6	40	1,011.2	1,014.9	-1.4	83	59	70.9	+1.9	98	28	46	8	33	14	60	76	1.96	-1.1	.88	7	4	.0	.0	6.9	w.	27	n.	5	4	17	10	6.0	70
New York[4]	314	415	454	1,004.4	1,015.6	-.7	82	68	74.8	+1.7	101	26	60	6	22	0	64	71	3.21	-1.1	1.29	9	3	.0	.0	10.7	nw.	37	s.	12	8	11	12	5.9	59
Allentown[3]	385	4	58	1,002.4	1,016.3	-----	84	62	72.5	+.4	99	26	51	8	31	1	63	80	4.33	-.1	1.77	9	4	.0	.0	----	w.	--	----	--	5	11	15	6.4	--
Harrisburg[3]	374	30	49	1,002.4	1,015.9	-.7	83	63	73.1	+.5	100	28	54	10	29	2	63	78	3.70	-.3	1.21	9	8	.0	.0	5.3	w.	19	nw.	6	6	10	15	6.2	61
Philadelphia[4]	114	174	150	1,011.5	1,015.6	-1.0	83	68	75.9	+1.1	101	26	60	6	24	0	66	80	5.39	+.8	1.31	11	8	.0	.0	6.3	w.	18	nw.	6	8	11	12	5.8	59
Reading	323	47	306	1,004.1	1,015.6	-.7	84	64	73.8	+.9	101	27	54	8	31	1	----	--	5.15	+.9	1.66	11	6	.0	.0	7.7	n.	40	nw.	7	9	8	14	6.1	64
Scranton	805	72	104	987.1	1,015.9	-1.0	81	61	70.8	+1.0	98	26	49	8	30	8	----	--	2.14	-1.6	.83	8	1	.0	.0	5.5	n.	20	n.	31	4	22	5	5.4	70
Atlantic City	52	37	172	1,013.5	1,015.2	-1.1	80	68	73.7	+1.2	97	29	59	6	22	0	68	86	8.23	+3.7	4.97	7	3	.0	.0	11.5	s.	30	n.	31	11	8	12	5.4	63
Newark[3]	30	5	46	1,014.2	1,015.2	-----	84	66	74.7	+1.7	103	26	57	7	30	0	64	73	4.35	-.6	1.08	10	3	.0	.0	----	ne.	--	----	--	7	11	13	6.0	--
Trenton	190	89	107	1,008.5	1,015.2	-1.1	82	66	74.2	+1.2	99	26	57	8	25	0	----	--	4.71	.0	1.13	10	8	.0	.0	7.0	s.	22	nw.	6	10	9	12	5.5	56
Baltimore[4]	123	100	215	1,011.5	1,015.9	-.4	85	68	76.6	+1.1	102	27	57	6	25	0	66	77	5.75	+1.4	1.94	13	11	.0	.0	8.5	s.	30	nw.	29	12	9	10	4.9	68
Washington[4]	112	56	100	1,012.2	1,016.3	.0	86	66	76.0	+1.0	100	28	56	6	26	0	66	76	8.00	+4.0	2.96	10	8	.0	.0	5.2	sw.	29	w.	11	10	13	8	4.9	72
Cape Henry	18	8	54	1,015.2	1,015.9	-.4	83	70	76.4	-.5	96	29	64	16	20	0	70	84	7.35	+2.5	2.90	11	10	.0	.0	8.4	s.	46	nw.	19	12	9	10	4.8	69
Lynchburg[3]	686	5	58	992.2	1,016.6	-.3	84	64	74.2	-.1	98	28	53	6	27	0	66	84	8.26	+4.5	3.22	11	10	.0	.0	5.9	n.	26	se.	21	11	11	9	4.9	71
Norfolk[4]	91	80	125	1,013.2	1,016.6	-.3	86	70	78.0	+.6	100	29	62	6	24	0	68	83	5.15	-.1	2.76	8	7	.0	.0	7.3	sw.	26	w.	4	11	10	10	5.2	70
Richmond[4]	144	11	52	1,010.5	1,015.6	-1.0	86	67	76.2	-.3	99	29	58	7	29	0	67	83	6.38	+2.0	3.45	13	7	.0	.0	5.3	s.	30	nw.	29	13	12	6	4.5	71
SOUTH ATLANTIC									78.2	+.4								78	5.09	-.6														5.3	
Asheville	2,253	77	92	944.6	1,017.3	0	83	62	72.2	+1.7	98	29	50	6	35	3	62	84	4.75	+.6	2.16	10	6	.0	.0	5.1	nw.	28	nw.	29	5	14	12	6.3	59
Charlotte[4]	779	63	86	989.2	1,016.3	-.6	88	68	78.0	+.9	100	29	58	6	26	0	66	75	6.18	+1.1	3.18	13	9	.0	.0	5.3	s.	21	w.	30	12	13	6	4.9	68
Greensboro[3]	886	6	56	985.8	1,017.3	0	87	64	75.6	.0	100	29	54	7	33	0	65	78	4.49	-.8	2.21	11	12	.0	.0	5.5	ne.	28	ne.	14	9	13	9	5.1	65
Hatteras	11	5	47	1,015.6	1,015.9	-.7	83	74	78.5	+.5	89	28	66	7	14	0	72	80	4.83	-.9	2.64	10	6	.0	.0	10.2	sw.	27	sw.	4	8	14	9	5.6	73
Raleigh[4]	376	5	71	1,000.7	1,016.6	0	88	67	77.8	+.8	102	29	57	7	28	0	66	78	5.41	.0	1.84	11	7	.0	.0	5.3	sw.	20	sw.	4	7	17	7	5.2	65
Wilmington	72	73	107	1,015.2	1,016.6	-.3	87	71	78.8	+1.2	95	28	64	7	23	0	70	80	4.07	-2.3	1.96	8	7	.0	.0	7.6	n.	34	nw.	31	10	14	7	5.0	72
Charleston[4]	48	11	92	1,014.2	1,015.9	-1.0	86	73	79.8	-1.2	96	14	67	6	25	0	70	82	4.10	-2.4	1.35	11	7	.0	.0	9.1	e.	32	nw.	31	13	9	9	5.1	69
Columbia, S. C.[4]	347	70	91	1,008.1	1,016.3	-.6	90	69	79.4	-.2	100	28	62	6	30	0	68	74	4.57	-.9	1.19	10	7	.0	.0	6.3	s.	37	se.	30	12	12	7	4.7	68
Greenville, S.C.[3]	1,040	18	36	979.7	1,015.9	-.7	86	68	76.9	+1.1	100	29	57	6	29	0	66	74	4.25	-1.2	2.56	9	9	.0	.0	6.0	ne.	28	n.	12	12	9	10	5.3	64
Augusta[4]	182	62	77	1,000.7	1,015.6	-.7	91	70	80.6	+.2	102	30	64	7	33	0	66	69	4.37	-.7	1.97	9	6	.0	.0	4.9	s.	26	sw.	3	9	14	8	5.3	73
Savannah[3]	65	19	51	1,014.2	1,015.9	-.7	88	72	80.2	+.3	98	30	65	20	29	0	71	78	6.76	-.6	1.87	13	10	.0	.0	8.4	e.	50	nw.	30	7	18	6	5.3	67
Jacksonville[4]	43	86	110	1,014.6	1,015.6	-1.3	88	73	80.9	-.8	96	15	70	15	26	0	72	80	7.27	+1.5	2.94	13	5	.0	.0	7.3	e.	35	nw.	15	4	17	10	6.1	47
FLORIDA PENINSULA									82.7	+.3								78	6.32	+.1														6.4	
Key West[4]	21	10	64	1,014.9	1,015.2	-.4	90	80	84.9	+1.4	93	15	73	27	16	0	75	74	2.73	-1.8	1.22	9	6	.0	.0	7.3	e.	27	w.	1	7	17	7	5.8	58
Miami[4]	25	242	249	1,014.9	1,015.2	-1.4	86	76	81.3	-.8	90	16	70	2	16	0	74	80	7.81	+1.9	2.41	15	17	.0	.0	10.5	se.	38	se.	20	4	15	12	6.5	60
Tampa[3]	35	5	36	1,015.2	1,015.6	-1.0	90	74	81.9	+.4	95	15	70	21	22	0	73	81	8.43	+.2	2.47	15	20	.0	.0	6.5	e.	25	sw.	12	2	16	13	7.0	63
EAST GULF									79.9	-.4								78	6.56	+1.3														5.5	
Atlanta[3]	1,173	33	72	982.1	1,015.9	-1.0	87	68	77.3	-.7	98	30	58	6	25	0	66	74	4.20	-.5	1.41	10	6	.0	.0	6.4	e.	33	se.	1	14	6	11	5.1	71
Macon[4]	370	79	87	999.3	1,015.6	-1.0	89	69	78.9	-1.0	100	30	59	6	29	0	68	73	3.61	-.7	1.04	10	11	.0	.0	4.6	e.	24	ne.	30	9	11	11	5.6	76
Thomasville	273	48	----	1,007.1	1,016.9	+1.0	89	71	79.7	-1.3	97	31	64	22	29	0	----	--	4.31	-1.4	.95	12	9	.0	.0	----	----	--	----	--	0	14	17	----	--
Apalachicola	35	11	51	1,013.5	1,014.9	-1.4	86	74	79.9	-1.3	90	15	70	7	18	0	74	84	13.61	+6.1	2.98	16	17	.0	.0	6.6	se.	29	ne.	21	9	9	13	5.9	49
Pensacola[4]	56	54	79	1,010.8	1,014.9	-1.4	89	74	81.4	+.5	95	15	70	22	20	0	73	80	4.39	-3.6	1.22	13	14	.0	.0	6.3	w.	23	nw.	31	5	17	9	5.8	66
Anniston	618	6	32	994.6	1,016.3	-.7	88	66	77.2	-1.0	98	30	56	6	31	0	69	82	5.46	+1.4	1.61	10	12	.0	.0	----	e.	--	----	--	----	----	----	----	--
Birmingham[3]	700	5	63	993.6	1,015.6	-1.3	88	68	78.0	-.5	96	29	56	6	28	0	67	76	4.10	-.2	1.79	9	10	.0	.0	5.5	e.	28	e.	30	10	10	11	5.5	59
Mobile[4]	57	86	161	1,007.5	1,015.2	-1.1	91	73	82.1	+1.1	97	15	69	22	23	0	72	80	10.92	+4.0	4.27	15	17	.0	.0	6.1	n.	29	nw.	14	2	21	8	6.4	53
Montgomery[4]	218	92	105	1,007.8	1,014.9	-1.7	89	72	80.4	-.4	98	30	64	6	24	0	70	76	3.42	-.8	2.01	10	9	.0	.0	5.4	e.	20	n.	15	14	9	8	4.8	75
Meridian[4]	375	67	92	1,004.4	1,015.2	-.7	90	69	79.9	+.4	98	30	62	6	27	0	69	77	5.56	+1.0	1.64	11	7	.0	.0	4.4	n.	19	w.	16	14	11	6	4.5	74
Vicksburg[4]	247	82	102	1,005.8	1,014.9	-1.4	90	71	80.3	-.5	96	13	66	2	25	0	70	79	10.02	+6.6	5.31	7	11	.0	.0	6.7	n.	38	w.	15	14	8	9	4.5	70
New Orleans C. O.	53	76	84	1,012.9	1,014.9	-1.0	90	75	82.3	+.1	96	20	71	23	24	0	73	79	9.84	+4.0	2.90	15	14	.0	.0	5.6	se.	26	e.	21	4	14	13	6.2	61
New Orleans A. P.[3]	30	6	52	1,012.9	1,014.6	-----	90	74	81.7	-----	95	21	68	22	25	0	72	82	5.79	-----	-----	16	17	.0	.0	----	e.	--	----	--	7	15	9	5.8	--
WEST GULF									84.4	+1.5								69	2.14	-1.1														4.3	
Shreveport[3]	181	5	64	1,005.8	1,014.6	-.6	97	72	84.6	+2.0	105	13	63	6	32	0	69	68	1.06	-1.6	.40	4	4	.0	.0	7.5	e.	33	se.	28	12	11	8	4.6	87
Fort Smith[3]	463	6	30	999.0	1,014.9	+.3	90	69	79.4	-1.1	97	13	59	5	29	0	68	77	3.39	+.1	2.04	14	12	.0	.0	6.0	ne.	22	nw.	12	10	6	15	5.5	67
Little Rock[3]	265	26	58	1,003.4	1,015.9	+.3	88	70	79.2	-.6	96	13	62	6	26	0	70	78	3.31	-.4	.80	10	8	.0	.0	5.8	ne.	24	ne.	30	13	5	13	4.8	68
Austin[3]	621	5	41	992.2	1,013.2	-1.0	98	73	85.8	+2.0	103	22	70	3	33	0	66	61	.27	-1.8	.15	3	4	.0	.0	8.8	s.	27	se.	24	16	10	5	3.8	86
Brownsville[3]	20	5	54	1,010.2	1,012.2	-1.0	94	75	84.6	+.7	99	16	70	23	26	0	74	78	1.38	-1.5	.96	5	5	.0	.0	10.2	se.	24	se.	13	13	12	6	4.8	79
Corpus Christi[3]	44	6	33	1,012.5	1,013.5	-1.1	95	75	84.6	+3.0	100	16	70	19	29	0	74	80	4.14	-----	3.15	5	7	.0	.0	11.3	s.	29	s.	8	12	15	4	4.0	78
Dallas[3]	488	34	45	995.9	1,013.9	-.7	98	75	86.2	+2.7	107	20	65	5	31	0	65	56	.54	-2.2	.30	3	2	.0	.0	8.5	se.	24	se.	25	18	10	3	3.5	90
Fort Worth[3]	706	40	56	990.2	1,013.5	-.4	98	74	85.8	+3.1	106	20	64	5	31	0	64	56	.90	-1.7	.53	4	5	.0	.0	9.0	e.	40	nw.	30	17	11	3	3.6	85
Galveston[4]	54	122	129	1,012.2	1,014.2	-1.0	88	78	83.0	.0	93	3	71	28	20	0	74	78	2.62	-1.7	1.23	10	8	.0	.0	12.1	s.	29	e.	28	17	10	4	4.1	81
Houston[4]	138	157	190	1,008.8	1,013.5	-1.7	95	76	85.7	+2.5	100	20	72	24	24	0	73	78	1.25	-2.9	.53	8	7	.0	.0	8.8	s.	34	e.	31	8	17	6	5.3	78
Laredo[3]	418	10	38	997.0	1,011.5	-----	101	77	89.0	+2.1	106	10	72	25	29	0	66	56	.15	-1.5	.13	3	1	.0	.0	----	se.	--	----	--	18	10	3	3.3	--
Palestine	510	64	72	996.6	1,014.2	-1.0	96	73	84.5	+2.7	103	21	67	6	29	0	65	60	.36	-1.8	.14	5	3	.0	.0	6.5	ne.	26	e.	28	14	15	2	3.8	86
Port Arthur[4]	34	59	134	1,012.9	1,013.9	-1.3	92	76	84.0	+.8	97	21	72	6	22	0	72	81	4.75	-1.3	1.01	10	10	.0	.0	11.6	s.	37	w.	16	13	10	8	4.8	76
San Antonio[3]	794	6	51	989.2	1,013.2	-.7	98	72	85.2	+1.7	103	20	66	26	33	0	66	62	5.83	+3.4	5.21	7	5	.0	.0	8.3	s.	27	se.	27	18	7	6	4.2	77

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS, AUGUST 1948—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Greatest daily range	Total heating degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date	Character of day (sunrise to sunset) Number of days: Clear	Partly cloudy	Cloudy	Average cloudiness, tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p.h.					0-3	0-7	8-10	0-10	
OHIO VALLEY AND TENNESSEE									74.8	+.5								72	2.24	-1.2														4.6	
Chattanooga [2]	762	6	66	991.9	1,016.3	-.3	88	66	77.0	+1.3	99	29	56	6	33	0	67	77	3.24	-.8	2.37	5	3	.0	.0	5.0	n.	26	n.	4	12	9	10	5.3	56
Knoxville [2]	995	27	71	982.1	1,016.6	-.3	87	66	76.6	+1.2	102	29	57	7	32	0	65	72	1.71	-2.2	.93	8	6	.0	.0	5.0	ne.	24	w.	4	11	9	11	5.4	42
Memphis [2]	399	5	49	1,005.4	1,015.2	-.7	90	68	78.9	+.5	96	22	58	6	30	0	68	73	2.62	-.7	2.30	5	5	.0	.0	5.8	n.	25	sw.	13	13	11	7	4.7	79
Nashville [2]	546	5	72	994.6	1,016.3	-.3	90	67	78.4	+.6	99	28	55	6	34	0	64	67	2.07	-1.6	.98	7	5	.0	.0	5.6	s.	24	e.	28	12	12	7	4.6	75
Lexington [2]	989	4	58	982.1	1,017.6	+1.3	86	62	74.2	-.3	99	26	51	6	32	2	61	70	2.61	-.8	1.24	6	5	.0	.0	-----	-----	--	-----	--	14	12	5	4.4	--
Louisville [2]	525	5	54	999.7	1,016.6	.0	90	63	76.2	+.1	100	25	54	6	35	0	62	66	1.34	-2.1	.85	8	4	.0	.0	4.6	e.	34	nw.	30	16	11	4	4.0	70
Evansville [2]	431	6	40	1,001.0	1,016.3	.0	88	62	75.0	.0	98	24	52	6	34	0	64	73	1.63	-1.7	.71	6	8	.0	.0	5.0	n.	28	se.	18	13	13	5	4.4	86
Indianapolis [2]	823	5	54	987.5	1,016.9	+.3	86	61	73.6	+1.2	97	26	50	6	31	3	61	68	1.04	-----	.52	5	4	.0	.0	6.4	ne.	27	nw.	13	11	15	5	4.6	78
Terre Haute [2]	575	4	36	996.6	1,017.3	+1.4	88	61	74.2	-.6	97	25	49	6	32	5	62	70	.99	-2.3	.50	6	5	.0	.0	5.9	se.	34	s.	17	11	15	5	4.6	75
Cincinnati [4]	627	135	148	994.6	1,017.3	+.7	88	66	76.7	+3.1	102	27	57	6	31	0	62	69	2.58	-.8	1.11	8	5	.0	.0	3.6	ne.	18	nw.	30	17	11	3	4.0	71
Columbus [4]	822	90	110	987.8	1,017.3	+.7	85	63	74.4	+1.4	100	27	51	6	28	2	61	71	2.31	-1.0	1.12	5	4	.0	.0	6.4	n.	28	s.	11	19	9	3	3.5	80
Dayton [2]	1,003	6	55	981.7	1,017.3	+1.0	84	62	73.0	+.1	97	27	51	6	27	4	59	66	2.08	-1.2	.76	6	4	.0	.0	6.4	n.	27	nw.	11	15	11	5	4.1	81
Elkins [2]	1,947	5	45	949.9	1,018.0	+.4	80	56	67.8	-.5	95	27	46	7	33	29	60	90	3.66	-.2	.88	13	10	.0	.0	4.3	nw.	28	w.	18	4	18	9	6.3	67
Parkersburg	637	77	84	-----	-----	-----	85	62	73.5	-.4	100	27	52	6	31	2	64	82	2.89	-.6	.86	8	5	.0	.0	4.8	nw.	18	nw.	4	12	14	5	4.6	74
Pittsburgh [2]	842	39	54	986.8	1,016.9	+.3	82	62	71.8	+.5	99	27	52	7	27	9	59	72	2.90	-.3	2.01	10	7	.0	.0	7.6	n.	26	n.	5	9	16	6	5.0	43
LOWER LAKES									71.0	+1.8								73	2.36	-.6														4.8	
Buffalo [2]	768	34	96	988.8	1,016.3	+.4	81	60	70.2	+1.8	99	27	47	7	32	17	59	72	1.10	-2.0	.51	5	4	.0	.0	10.5	sw.	33	sw.	1	7	18	6	5.3	81
Canton	448	10	61	998.6	1,014.2	-.7	80	58	68.9	+2.4	95	26	45	31	29	28	58	74	2.18	-1.5	.50	12	9	.0	.0	6.2	w.	21	sw.	1	9	11	11	5.6	65
Oswego	335	71	85	1,003.1	1,015.2	-.7	77	62	69.7	+1.9	94	28	54	10	24	11	60	74	2.25	-.4	1.42	7	6	.0	.0	7.6	w.	22	n.	31	14	12	5	4.4	69
Rochester [2]	523	4	69	997.0	1,015.9	-.4	82	59	70.2	+1.0	99	26	46	7	34	19	59	75	1.82	-1.1	1.06	6	5	.0	.0	8.0	sw.	26	w.	1	8	17	6	5.1	64
Syracuse [2]	596	5	57	994.2	1,015.9	-.7	82	58	70.0	+2.7	98	28	47	31	32	20	60	77	2.53	-.3	1.20	10	6	.0	.0	7.9	sw.	43	nw.	28	9	12	10	5.5	60
Erie [4]	714	57	81	991.2	1,016.6	+.3	78	65	71.4	+1.8	92	26	56	10	24	5	61	79	1.71	-1.6	.61	8	5	.0	.0	6.2	w.	17	w.	17	12	14	5	4.4	62
Cleveland [2]	762	27	54	989.5	1,016.9	+.3	84	60	71.8	+1.6	102	27	52	10	35	2	60	71	4.47	+1.7	2.43	8	3	.0	.0	7.2	n.	30	w.	12	12	14	5	4.6	71
Sandusky	629	5	67	994.2	1,016.9	+.6	82	63	72.8	+1.0	96	28	55	2	28	0	-----	-----	2.92	-.2	1.49	5	3	.0	.0	6.9	ne.	27	nw.	11	21	5	5	3.5	77
Toledo [2]	628	5	47	994.2	1,016.9	+.3	83	60	71.2	+1.0	99	27	48	6	29	5	60	71	2.85	0	1.14	4	2	.0	.0	7.6	sw.	32	nw.	11	12	12	7	4.6	76
Fort Wayne [2]	857	5	34	986.5	1,017.3	+.7	84	60	72.2	+1.3	96	27	49	6	29	7	59	68	2.10	-1.0	1.05	6	4	.0	.0	5.5	n.	26	nw.	11	11	17	3	4.2	82
Detroit [2]	730	5	77	991.2	1,017.6	+1.0	83	62	72.1	+2.9	98	25	51	6	28	4	58	66	2.05	-.7	.61	6	3	.0	.0	7.2	n.	41	nw.	11	10	13	8	5.1	67
UPPER LAKES									69.2	+3.0								71	1.52	-1.4														4.8	
Alpena	609	5	89	994.6	1,017.3	+.7	77	59	67.8	+3.7	100	25	49	7	26	40	58	72	1.10	-1.8	.72	12	5	.0	.0	8.7	nw.	26	nw.	1	11	12	8	5.0	71
Escanaba	612	51	72	994.6	1,016.9	+1.0	74	59	66.2	+1.9	84	24	50	5	25	47	58	76	2.51	-.7	1.72	8	5	.0	.0	8.7	s.	27	n.	4	10	13	8	4.9	66
Grand Rapids [4]	707	70	244	991.5	1,016.9	+.6	84	63	73.2	+3.5	97	24	51	5	27	2	57	64	.68	-1.9	.53	6	5	.0	.0	8.6	n.	29	sw.	28	10	14	7	4.8	78
Lansing [4]	878	5	90	985.8	1,017.3	+1.0	83	58	70.8	+1.5	98	27	46	6	32	12	57	66	1.86	-1.0	1.58	8	5	.0	.0	6.9	nw.	26	nw.	11	11	14	6	4.6	72
Marquette	734	44	73	989.2	1,016.3	+.4	74	58	66.0	+2.2	101	24	48	9	27	78	56	72	2.10	-.6	.97	8	6	.0	.0	7.4	w.	29	sw.	23	8	13	10	5.5	68
Sault Sainte Marie [2]	614	10	52	993.6	1,015.9	+.0	75	55	64.8	+4.0	93	27	44	31	29	88	57	80	1.76	-.9	1.10	10	4	.0	.0	8.7	nw.	29	nw.	1	10	11	10	5.2	69
Chicago [2]	673	5	38	992.9	1,017.3	+1.0	82	64	72.8	+2.0	98	24	50	6	28	2	60	67	2.50	-.5	.77	10	7	.0	.0	6.8	ne.	26	nw.	11	13	12	6	4.5	76
Green Bay [2]	617	5	32	994.2	1,016.9	+1.3	82	59	70.5	+2.8	100	24	50	5	35	6	58	66	.96	-2.2	.29	8	6	.0	.0	6.7	se.	21	se.	23	12	9	10	4.9	72
Milwaukee [2]	681	33	66	992.6	1,017.3	+1.0	82	63	72.0	+4.4	100	24	53	5	26	3	60	69	.46	-2.2	.34	3	2	.0	.0	10.4	sw.	30	sw.	24	10	14	7	4.9	62
Duluth [4]	1,133	5	47	974.9	1,015.9	+.7	76	57	66.8	+4.2	94	24	50	3	26	47	56	76	1.23	-2.0	.73	9	4	.0	.0	8.7	ne.	25	nw.	15	15	10	6	4.1	73
NORTH DAKOTA									70.0	+4.0								63	.76	-1.4														4.7	
Fargo [2]	940	5	47	980.0	1,013.9	-.3	82	57	70.0	+3.9	100	24	47	1	39	16	58	69	.79	-2.1	.25	9	7	.0	.0	10.4	s.	44	n.	16	11	11	9	5.0	62
Bismarck [2]	1,677	5	41	953.9	1,013.2	-1.0	86	56	71.0	+4.3	98	16	43	1	41	22	56	64	1.18	-.6	.41	6	7	.0	.0	9.7	se.	33	nw.	13	14	10	7	4.6	68
Devils Lake	1,478	11	44	961.4	1,014.2	-.7	82	55	68.4	+3.6	94	19	46	4	38	34	55	62	.63	-1.8	.23	7	5	.0	.0	7.2	se.	26	ne.	13	13	12	6	4.4	78
Williston	1,878	42	50	946.2	1,011.5	-1.7	84	57	70.4	+4.3	98	19	43	3	41	12	52	56	.46	-1.0	.28	5	9	.0	.0	6.8	se.	25	ne.	22	12	12	7	4.8	57
UPPER MISSISSIPPI									74.8	+2.3								70	1.76	-1.5														4.8	
Minneapolis-St. Paul [2]	919	43	74	982.4	1,015.2	+.6	83	62	72.7	+2.8	98	24	45	5	35	6	60	68	3.37	+.2	2.10	10	6	.0	.0	9.2	se.	38	se.	9	14	10	7	4.3	70
La Crosse [2]	672	5	29	990.2	1,015.9	+.7	86	60	72.9	+3.4	104	24	49	5	40	16	58	65	1.00	-2.7	.50	7	6	.0	.0	7.4	s.	25	sw.	23	14	10	7	4.4	74
Madison [2]	974	27	39	982.4	1,017.3	+1.0	84	60	72.4	+2.9	98	24	46	5	37	4	58	66	.70	-2.5	.34	6	6	.0	.0	7.8	sw.	26	sw.	24	11	13	7	4.8	75
Charles City	1,015	10	51	980.7	1,016.9	+1.7	85	60	72.6	+4.3	98	23	48	5	33	12	-----	-----	1.53	-2.0	.46	9	7	.0	.0	5.7	s.	20	s.	23	15	9	7	4.5	65
Moline [2]	606	6	50	994.9	1,017.3	+1.4	85	62	73.6	+1.9	95	24	49	6	32	4	63	71	2.83	-.7	1.29	8	6	.0	.0	6.1	e.	35	ne.	29	11	11	9	5.0	76
Des Moines [4]	860	5	99	-----	1,016.3	+1.4	87	66	76.3	+3.2	100	23	52	5	31	1	64	72	1.54	-2.0	.61	11	9	.0	.0	7.8	se.	26	w.	11	13	11	8	4.6	71
Dubuque [2]	699	60	79	991.5	1,016.6	+1.7	84	64	74.2	+2.5	97	24	52	6	31	0	62	72	3.17	-.1	.95	7	8	.0	.0	4.3	s.	23	n.	29	11	12	8	5.0	78
Burlington [2]	702	4	36	991.5	1,016.6	+1.4	87	63	74.9	+.9	101	23	50	6	32	2	64	76	2.50	-1.0	1.57	6	3	.0	.0	6.9	s.	28	n.	30	9	12	10	5.2	79
Cairo [2]	357	5	99	1,003.4	1,015.9	-.7	89	69	79.4	+.6	98	24	60	5	27	0	-----	-----	.85	-2.2	.38	6	4	.0	.0	5.6	ne.	33	e.	29	13	13	5	4.5	82
Peoria [2]	609	7	26	995.3	1,016.9	+.3	86	63	74.3	+1.2	95	24	51	5	33	4	62	70	.81	-2.3	.38	6	5	.0	.0	6.4	sw.	29	ne.	29	11	10	10	5.1	81
Springfield, Ill. [4]	636	5	191	993.9	1,016.9	+1.0	86	63	74.8	+2.6	94	22	50	6	30	3	64	72	2.03	-1.1	1.01	5	5	.0	.0	7.3	e.	42	n.	30	12	9	10	5.0	81
St. Louis [4]	568	33	59	996.6	1,015.9	+.3	88	70	79.0	+1.5	99	23	59	5	29	0	-----	66	.84	-2.1	.56	4	4	.0	.0	7.4	s.	31	s.	28	15	12	4	-----	78
MISSOURI VALLEY									76.3	+2.9								73	3.16	-.2														4.5	
Columbia, Mo. [4]	784	6	66	988.5	1,016.3	+2.4	88	67	77.1	+.8	98	23	55	5	28	0	66	78	4.60	+1.0	1.79	8	7	.0	.0	5.1	s.	19	w.	27	11	13	7	4.9	68
Kansas City [2]	963	38	76	981.7	1,015.2	+2.4	89	70	79.2	+4.7	100	22	57	5	29	0	66	65	2.71	-.8	1.27	7	5	.0	.0	8.1	sw.	25	ne.	2	10	14	7	4.8	64
St. Joseph [2]	967	5	51	981.4	1,015.6	+1.4	88	67	77.6	+1.1	100	22	53	5	31	1	67	78	4.36	+.5	3.08	8	9	.0	.0	6.1	s.	29	se.	12	16	6	9	4.4	59
Springfield, Mo. [2]	1,324	5	50	969.9	1,016.6	+1.0	85	65	75.0	.0	95	22	56	5	29	1	68	84	2.04	-2.0	1.03	9	7	.0	.0	7.7	s.	26	ne.	2	10	7	14	5.0	76
Topeka [4]	987	65	87	980.7	1,015.6	+2.4	90	69	79.5	+3.3	102	22	57	5	29	0	67	76	1.88	-2.2	1.13	5	5	.0	.0	7.2	s.	28	nw.	10	9	15	7	5.2	--
Lincoln [4]	1,189	6	81	972.6	1,014.6	+.7	89	67	77.8	+3.4	103	22	55	5	31	5	63	70	3.55	.0	1.12	9	9	.0	.0	8.3	s.	41	nw.	13	16	9	6	4.2	77
Norfolk, Nebr [2]	1,551	5	38	960.0	1,014.6	-----	86	63	74.8	+1.7	101	29	52	5	35	12	62	70	3.42	+.3	1.38	8	8	.0	.0	-----	s.	-----	-----	--	16	10	5	3.8	--
Omaha [2]	1,105	5	68	976.0	1,014.9	+.3	88	66	76.9	+3.7	100	23	52	5	29	3	64	72	3.48	+.4	1.14	9	8	.0	.0	9.9	s.	44	nw.	13	18	9	4	3.9	74
Valentine	2,598	46	54	923.8	1,013.9	-.7	88	60	74.2	+2.5	104	29	47	4	44	11	54	60	2.70	+.5	1.40	8	7	.0	.0	7.8	s.	35	n.	12	16	11	4	4.1	83
Sioux City [2]	1,138	5	40	973.9	1,014.2	0	86	63	74.8	+3.7	100	23	47	5	31	10	64	73	3.53	+.4	1.59	10	7	.0	.0	8.5	s.	31	nw.	10	18	6	7	4.0	75
Huron [2]	1,301	5	41	967.8	1,013.9	-.3	86	59	72.3	+2.9	101	23	46	1	39	18	61	74	2.48	.0	1.12	8	6	.0	.0	10.2	se.	30	se.	19	13	8	10	4.9	71
NORTHERN SLOPE									68.7	+1.9								52	1.25	+.2														4.5	
Billings [2]	3,570	16	39	800.6	1,011.5	-2.7	87	57	72.0	+1.4	100	18	50	21	42	1	44	40	.48	-----	.19	8	8	.0	.0	8.3	w.	59	nw.	19	18	10	3	3.9	82
Butte	5,533	44	58	831.4	1,016.3	-----	77	42	59.2	-1.5	89	20	36	21	47	177	42	58	1.58	+.7	.65	10	12	.0	.0	-----	s.	--	-----	--	14	9	8	4.7	--
Glasgow	2,086	34	53	938.7	1,011.5	-----	89	56	72.8	+4.2	107	18	46	21	44	1	49	47	.88	-.4	.48	8	7	.0	.0	-----	e.	--	-----	--	14	13	4	4.1	--
Great Falls [2]	3,657	16	75	888.3	1,012.5	-----	82	56	68.6	+1.5	95	18	47	7	33	13	43	44	.50	-.7	.13	6	6	.0	.0	4.8	sw.	38	sw.	24	13	14	4	4.3	88
Havre	2,507	11	67	924.8	1,012.2	-1.7	86	55	70.2	+4.8	99	18	48	21	41	2	44	43	.28	-.9	.13	4	4	.0	.0	7.9	w.	34	sw.	4	16	13	2	4.0	85
Helena [2]	4,124	5	43	873.7	1,013.2	-1.0	81	50	65.6	+1.0	94	15	42	21	43	39	47	55	1.02	+.2	.63	6	12	.0	.0	7.5	w.	38	w.	23	13	14	4	4.5	76
Missoula [2]	3,263	4	32	901.8	1,014.2	0	80	48	64.2	.0	94	29	41	20	44	67	46	58	.24	-.5	.12	6	7	.0	.0	6.2	nw.	27	nw.	10	9	13	9	5.5	69
Kalispell	2,973	48	56	911.6	1,013.2	-.7	75	50	62.3	-.5	85	18	43	7	36	104	50	67	2.33	+1.5	1.50	8	8	.0	.0	5.5	w.	24	sw.	23	8	15	8	5.4	81
Miles City [2]	2,371	5	28	929.6	1,011.9	-2.0	89	59	74.0	-----	105	30	49	3	44	1	49	46	.60	-----	.29	5	8	.0	.0	-----	se.	--	-----	--	17	7	7	4.2	--
Rapid City [2]	3,259	5	56	901.8	1,013.2	-1.4	86	58	71.6	+2.1	102	30	48	3	42	18	52	58	3.06	+1.4	1.31	8	11	.0	.0	11.8	se.	60	sw.	13	12	12	7	4.8	70
Cheyenne [2]	6,094	22	40	816.1	1,013.9	-.7	82	53	67.4	+1.8	90	16	46	21	42	23	42	50	.86	-.7	.22	12	10	.0	.0	9.1	w.	35	w.	22	6	18	7	5.5	61
Lander [2]	5,352	6	30	837.1	1,013.2	-.7	86	53	69.2	+3.7	94	30	44	9	40	7	38	39	.26	-.3	.16	3	6	.0	.0	8.6	sw.	43	sw.	23	20	7	4	3.8	70
Sheridan [2]	3,790	5	38	884.2	1,018.6	+2.7	87	54	70.2	+3.7	101	30	46	21	48	6	45	48	1.06	+.2	.29	8	11	.0	.0	7.1	s.	56	nw.	19	16	9	6	3.9	75
North Platte [4]	2,821	11	51	917.0	1,013.5	-.7	88	60	73.9	+3.1	100	19	49	4	37	11	60	70	4.25	+1.9	1.52	9	12	.0	.0	6.1	s.	24	ne.	12	11	16	4	4.7	73

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS, AUGUST 1948—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air, Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Greatest daily range	Total heating degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Character of day (sunrise to sunset) Number of days: Clear	Partly cloudy	Cloudy	Average cloudiness, tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	0-7	8-10	0-10	
MIDDLE SLOPE									77.0	+.5								66	2.45	-.1														4.5	
Denver [4]	5,292	106	113	840.5	1,013.5	-1.1	87	61	74.0	+3.3	94	31	55	14	33	2	44	44	.19	-1.2	.06	5	9	.0	.0	7.3	s.	28	se.	21	5	22	4	5.2	69
Pueblo [2]	4,690	5	36	858.8	1,013.9	+.4	88	58	73.2	+.5	96	19	49	26	42	0	52	59	3.01	+1.2	1.05	6	11	.0	.0	6.6	nw.	30	w.	13	11	15	5	4.4	78
Concordia	1,392	50	58	966.1	1,014.6	+.7	89	68	78.3	+1.8	102	17	55	5	30	0	62	66	.57	-2.3	.38	7	9	.0	.0	8.0	s.	19	sw.	22	18	9	4	3.6	72
Dodge City [2]	2,509	5	58	928.5	1,014.2	+.3	87	64	75.4	-2.3	98	23	56	4	33	4	62	70	3.61	+.9	.91	11	11	.0	.0	13.2	se.	49	nw.	2	16	7	8	4.2	68
Wichita [2]	1,358	52	64	967.5	1,014.9	+1.4	88	68	78.0	-.3	98	21	57	5	27	0	66	73	2.72	-.4	.98	8	6	.0	.0	10.9	s.	38	ne.	15	15	6	10	4.9	69
Oklahoma City [4]	1,214	10	47	972.2	1,014.6	+.7	92	71	81.4	+1.7	102	20	60	5	27	0	66	68	1.63	-1.3	.71	7	5	.0	.0	7.1	s.	17	se.	6	17	11	3	3.8	78
Tulsa [2]	674	10	60	991.2	1,014.9	-----	88	69	78.6	-1.5	96	20	59	5	25	0	70	82	5.43	+2.2	2.18	12	10	.0	.0	7.7	se.	45	n.	12	12	10	9	5.2	62
SOUTHERN SLOPE									82.2	+1.8								54	1.68	-.6														3.7	
Abilene [2]	1,755	4	59	953.6	1,012.5	-.7	98	72	84.8	+4.5	105	12	63	30	32	0	60	52	.37	-1.9	.29	3	7	.0	.0	11.7	s.	36	se.	25	16	13	2	3.6	84
Amarillo [2]	3,604	5	42	891.2	1,013.6	-.3	90	63	76.2	+1.6	96	10	58	24	34	0	58	60	5.16	+2.1	1.61	12	11	.0	.0	12.0	s.	34	e.	1	13	14	4	4.2	77
Del Rio	960	63	71	979.0	1,011.2	-1.0	97	75	86.4	+2.2	100	8	69	25	30	0	64	54	.39	-1.3	.37	2	1	.0	.0	8.2	se.	26	se.	1	19	12	0	3.1	87
Roswell	3,614	6	29	892.3	1,012.5	-.4	94	64	78.6	+2.0	100	20	58	19	37	0	54	51	1.03	-1.1	.49	6	14	.0	.0	7.4	se.	38	sw.	10	14	14	3	3.9	80
Wichita Falls	1,030	4	49	977.7	1,013.2	-----	97	72	84.8	-1.1	106	20	61	5	32	0	62	54	1.45	-.7	1.27	3	6	.0	.0	-----	se.	--	-----	--	16	12	3	3.5	---
SOUTHERN PLATEAU									81.8	+2.4								43	.96	-.6														3.8	
El Paso [2]	3,916	35	85	886.6	1,010.5	-.7	94	70	82.2	+4.2	100	10	61	2	29	0	52	40	1.82	+1.1	.74	4	6	.0	.0	9.1	se.	54	n.	29	19	10	2	3.2	88
Albuquerque [2]	5,314	5	45	840.5	1,011.9	+1.1	92	64	77.6	+3.7	96	28	59	27	34	0	50	46	.51	-.7	.29	9	14	.0	.0	7.8	nw.	31	sw.	11	19	9	3	3.7	76
Flagstaff	6,907	34	48	795.5	1,017.6	+7.1	82	49	65.5	+1.5	91	29	37	25	45	28	44	53	2.10	-.6	.80	8	10	.0	.0	-----	nw.	--	-----	--	8	12	11	5.5	---
Phoenix [4]	1,107	39	87	971.2	1,008.8	.0	104	78	88.5	+2.9	113	29	72	28	39	0	58	36	.25	-.7	.20	3	5	.0	.0	6.4	e.	26	e.	29	17	11	3	3.5	89
Tucson [2]	2,555	5	39	924.8	1,010.5	+2.0	99	72	85.2	+1.0	106	28	67	27	37	0	59	46	1.08	-1.3	.65	5	13	.0	.0	6.6	se.	30	sw.	6	9	17	5	5.0	78
Yuma	142	9	54	1,003.1	1,007.8	-.3	107	76	91.8	+1.4	116	29	69	26	42	0	61	39	T	-.5	T	0	0	.0	.0	5.2	s.	16	s.	30	27	4	0	1.6	96
MIDDLE PLATEAU									69.6	+.7								35	.52	-.2														2.6	
Ely [2]	6,262	8	41	811.0	1,014.2	-----	84	44	64.4	+3.1	90	31	31	24	50	65	28	26	.26	-.8	.18	3	4	.0	.0	12.9	s.	39	s.	22	25	5	1	2.2	94
Reno [2]	4,527	20	52	862.5	1,013.5	+1.0	88	43	65.2	-.5	95	28	38	14	53	36	36	38	.08	-.1	.05	2	1	.0	.0	7.8	s.	28	w.	9	27	3	1	1.7	95
Winnemucca	4,339	5	56	867.3	1,011.9	-1.3	90	48	68.6	-.7	98	29	42	12	51	10	34	31	T	-.2	T	0	1	.0	.0	7.1	sw.	24	sw.	7	24	7	0	1.7	95
Modena	5,473	10	46																																
Salt Lake City [2]	4,357	32	58	866.9	1,011.2	-1.0	91	60	75.6	+2.8	99	29	46	25	40	4	42	34	.49	-.4	.28	4	6	.0	.0	12.0	se.	45	w.	3	23	7	1	2.6	85
Grand Junction [2]	4,602	5	26	861.5	1,014.2	+.7	89	60	74.4	-1.0	97	1	51	26	40	0	46	44	1.78	+.6	.90	11	13	.0	.0	8.9	e.	31	sw.	7	11	14	6	4.6	73
NORTHERN PLATEAU									66.7	-1.2								53	.35	-.3														4.4	
Baker [4]	3,471	36	54	895.4	1,014.9	-.3	79	47	63.2	-1.4	91	29	37	20	43	78	48	64	.66	+.2	.35	5	6	.0	.0	5.6	se.	22	sw.	15	13	10	8	4.5	85
Meacham [2]	4,056	7	28	877.8	1,016.6	-----	73	46	59.5	-----	83	29	36	5	35	178	46	65	.74	-----	.22	7	6	.0	.0	-----	nw.	--	-----	--	15	8	8	4.5	---
Boise [2]	2,739	5	40	917.7	1,011.9	-1.0	86	54	70.4	-.6	95	3	44	24	39	16	42	38	.05	-.1	.05	1	0	.0	.0	8.8	nw.	27	w.	19	18	9	4	3.6	82
Burley [2]																																			
Lewiston	1,436	4	23	962.8	1,013.5	-----	83	54	68.8	-----	94	29	46	20	40	9	49	53	.15	-----	.07	4	3	.0	.0	-----	e.	--	-----	--	16	6	9	4.5	---
Pocatello [2]	4,478	5	31	863.2	1,012.9	.0	87	54	70.2	+1.3	96	29	43	21	47	7	39	35	.34	-.2	.13	5	7	.0	.0	9.2	s.	31	w.	10	20	10	1	3.0	82
Ellensburg [2]	1,735	5	58	953.3	1,014.6	-----	79	52	65.4	-1.4	90	2	42	16	40	45	48	58	.48	+.3	.23	6	10	.0	.0	-----	nw.	--	-----	--	13	14	4	4.4	---
Lacrosse	1,544	5	43	959.0	1,013.5	-----	82	50	65.7	-----	93	3	41	31	46	33	48	54	T	-----	T	0	5	.0	.0	-----	sw.	--	-----	--	12	13	6	4.7	---
Spokane [2]	1,929	6	51	945.8	1,014.2	+.3	78	52	65.2	-2.9	86	29	44	5	38	41	46	52	.27	-.4	.26	2	1	.0	.0	7.7	sw.	29	sw.	15	9	12	10	5.5	77
Walla Walla	991	57	65	978.7	1,013.9	+.4	83	59	71.0	-1.7	94	3	52	5	33	1	-----	-----	.39	-.1	.27	5	2	.0	.0	5.4	s.	19	w.	4	14	8	9	4.5	68
Yakima [2]	1,076	4	54	975.6	1,014.2	.0	84	51	67.6	-1.6	95	3	41	5	41	22	50	57	.44	+.1	.27	3	5	.0	.0	-----	nw.	--	-----	--	10	14	7	4.9	---
NORTH PACIFIC COAST									63.0	-.9								73	1.76	+1.0														6.8	
Kelso [2]	750	38	76	-----	-----	-----	71	52	61.4	-----	82	28	41	5	28	116	55	81	3.14	-----	1.10	13	1	.0	.0	-----	s.	--	-----	--	1	4	26	8.4	---
North Head	211	5	55	1,010.2	1,017.6	-.7	64	55	59.8	+2.2	68	16	53	3	13	160	56	89	2.72	+1.7	.69	17	1	.0	.0	9.8	nw.	34	s.	29	1	7	23	8.1	30
Seattle [4]	125	90	321	1,012.2	1,016.9	-.4	70	56	63.0	-2.1	80	28	53	8	22	74	55	78	1.44	+.7	.28	15	0	.0	.0	7.9	s.	24	s.	26	1	13	17	7.4	21
Tacoma	194	172	201	1,010.2	1,016.9	-.4	69	56	62.4	-.2	75	28	52	14	21	86	-----	-----	2.26	+1.5	.51	12	2	.0	.0	7.8	sw.	29	s.	15	4	10	17	7.3	28
Tatoosh Island	86	5	61	1,013.9	1,016.9	-1.1	60	52	55.8	+.5	65	29	47	8	13	289	54	94	5.06	+3.0	1.62	21	0	.0	.0	10.9	s.	40	s.	29	1	2	28	8.8	14
Burns	4,162	35	47	873.7	1,014.6	-----	81	45	63.1	-1.5	91	3	33	24	48	93	39	44	.17	-.1	.11	3	6	.0	.0	-----	n.	--	-----	--	14	11	6	4.1	---
Eugene [2]	433	4	35	1,003.4	1,016.9	-----	77	51	64.3	-----	88	28	42	20	42	44	54	72	.56	-----	.24	9	0	.0	.0	-----	n.	--	-----	--	4	10	17	6.5	---
Medford [2]	1,329	29	58	968.5	1,015.6	+1.7	83	52	67.7	-3.4	95	1	45	16	40	11	51	58	.16	.0	.16	1	1	.0	.0	-----	nw.	--	-----	--	18	11	2	3.3	---
Portland, Oreg. [4]	154	68	106	1,011.9	1,017.6	+1.0	74	57	65.8	-.9	85	28	50	5	28	17	55	72	1.55	+.9	1.01	9	0	.0	.0	5.0	nw.	15	n.	6	1	10	20	7.6	48
Roseburg	510	45	76	998.6	1,016.9	+1.0	79	54	66.3	-1.7	90	28	47	5	40	26	53	69	.54	+.2	.41	3	0	.0	.0	4.4	n.	15	n.	6	3	18	10	6.4	53
MIDDLE PACIFIC COAST									67.1	+1.5								65	.8	T														3.6	
Eureka	60	72	88	1,016.3	1,018.6	+1.3	62	54	58.0	+2.0	69	16	49	5	19	215	54	87	.13	.0	.12	2	0	.0	.0	5.9	nw.	21	nw.	19	6	11	14	6.4	44
Red Bluff [2]	353	5	26	999.7	1,012.2	-----	93	63	77.9	-1.8	102	1	56	23	36	0	48	37	.19	+.1	.19	2	1	.0	.0	6.8	se.	20	se.	21	27	1	3	2.0	94
Sacramento [4]	66	92	115	1,010.5	1,012.5	+.6	88	57	72.8	-.1	98	1	53	11	42	0	52	57	.00	.0	.00	0	0	.0	.0	7.6	s.	20	sw.	21	29	1	1	1.0	96
San Francisco [4]	155	112	132	1,009.5	1,015.2	+1.0	65	54	59.6	+.5	74	28	52	12	18	168	53	80	.02	.0	.02	2	0	.0	.0	10.6	w.	24	w.	30	11	13	7	4.9	65
SOUTH PACIFIC COAST									72.7	-.7								60	T	.0														2.5	
Fresno [2]	327	5	34	1,000.3	1,011.5	+.7	97	60	78.8	-.7	104	2	55	24	42	0	52	44	.00	.0	.00	0	0	.0	.0	6.7	nw.	22	nw.	7	29	2	0	1.2	100
Los Angeles	338	236	263	-----	-----	-----	83	60	71.2	+.1	95	30	56	29	32	0	-----	-----	T	.0	T	0	0	.0	.0	5.1	w.	17	w.	23	26	5	0	2.3	81
San Diego [2]	87	20	55	1,010.5	1,013.5	+.6	75	62	68.2	-1.6	81	30	60	9	21	0	59	75	.00	.0	.00	0	0	.0	.0	5.9	w.	15	nw.	23	13	18	0	3.9	71
ALASKA																																			
Anchorage [2]	132	6	44	1,008.8	1,013.9	-----	63	43	53.2	-2.4	70	11	31	24	30	363	45	74	1.86	-.7	.47	15	0	.0	.0	5.8	s.	31	s.	21	1	8	22	7.7	---
Annette Island	113	5	53	1,009.8	1,013.9	-----	65	52	58.4	-.2	79	14	43	25	23	212	51	80	5.60	+1.2	1.19	12	0	.0	.0	6.4	nw.	--	-----	--	6	10	15	6.4	---
Barrow	29	5	27	1,011.9	1,009.1	-----	41	31	36.0	-2.2	58	3	23	30	21	900	34	92	.78	.0	.36	14	0	.5	T	11.7	nw.	35	nw.	27	0	1	30	8.9	---
Bethel [2]	28	5	31	1,012.9	1,014.2	-----	56	45	50.4	-2.0	67	12	34	25	25	451	46	86	3.14	-.9	.79	22	0	.0	.0	8.0	s.	35	sw.	21	1	3	27	8.8	---
Cordova [2]	45	5	32	1,011.5	1,011.5	-----	62	42	51.6	-.5	74	12	30	25	34	418	47	86	4.29	-6.7	.90	18	0	.0	.0	-----	e.	--	-----	--	3	8	20	7.4	---
Fairbanks [2]	455	5	63	996.3	1,013.5	-----	60	40	50.2	-4.9	76	12	23	24	37	459	43	76	3.51	+1.5	.93	15	0	T	.0	6.7	sw.	22	sw.	27	3	6	22	7.5	---
Galena	139	4	66	1,007.1	1,011.9	-----	57	44	50.5	-1.7	72	13	30	24	28	449	42	72	2.84	-.1	1.13	13	0	T	.0	-----	sw.	30	sw.	27	2	6	23	8.0	---
Gambell	32	5	32	1,011.9	1,012.9	-----	46	40	43.4	-2.2	55	12	35	28	12	670	40	90	1.67	-.4	-----	14	-----	.0	.0	14.0	sw.	38	ne.	21	1	3	27	9.0	---
Juneau [2]	80	6	30	1,012.5	1,013.5	-----	64	43	53.4	+.6	75	15	27	25	32	360	45	74	3.39	-1.3	1.04	13	0	.0	.0	6.2	n.	26	se.	30	4	10	17	6.7	---
Kotzebue [2]	20	5	31	1,012.2	1,012.9	-----	52	42	47.3	-2.6	70	13	31	31	21	549	42	84	2.28	+.6	1.36	11	0	.0	.0	13.4	nw.	34	w.	27	4	3	24	8.0	---
McGrath [2]	341	5	31	1,001.4	1,014.2	-----	58	42	50.0	-2.9	73	12	28	24	45	465	44	78	3.27	-.2	1.26	18	0	T	.0	-----	s.	21	s.	2	3	2	26	8.0	---
Nome [2]	22	10	75	1,012.9	1,013.5	-----	50	39	44.8	-4.7	66	12	31	26	27	624	42	89	2.69	-.5	.60	14	0	.0	.0	11.8	sw.	33	nw.	29	3	5	23	8.0	---
Northway [2]	1,718	5	32	950.9	1,013.9	-----	61	40	50.0	-2.3	78	15	22	25	33	462	40	71	1.51	-.9	.49	11	0	1.8	.0	6.8	nw.	24	w.	17	1	6	24	8.1	---
HAWAII																																			
Honolulu [4]	38	86	98	1,014.6	1,015.9	-----	84	75	79.2	+.8	86	21	70	4	12	0	68	69	.85	-.4	.47	9	1	.0	.0	9.4	e.	22	e.	19	5	15	11	64 6	.3

[1] Height of barometer cistern above mean sea level on January 1, 1900, or when station was first established since January 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations according to note [1].

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records; remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport; remainder from city office records.

[6] Bihourly hygrometric data.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE LOCAL STORMS FOR AUGUST 1948

[The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Butte, Mont	1	2-3:30 p. m.			$250,000	Hail, wind, and rain	Some hail damage to dwellings, automobiles, and gardens. A little wind damage to trees. Considerable damage to automobiles, basements, roads, streets, and bridges by heavy water run-off.
Cuero Airport, De Witt County, Tex.	1	4 p. m.		0	25,000	Tornado	Damaged 3 hangars; scattered 25 airplanes; 10 planes completely demolished.
Douglas, Wyo	1	5 p. m.	[1] 2-4		401,100	Wind and hail	$400,000 damage to growing crops; $1,100 damage to livestock and property.
Missoula, Mont	1	5-6 p. m.				Hail and rain	Hail caused little damage. Heavy water run-off caused considerable damage to basements, roads, and streets.
Cody, Wyo	1					Rain	2 small bridges washed out by floodwaters.
Hebron, Thayer County, Nebr.	2	4:30 a. m.	[1] 1½		15,000	Hail	Hailstones size of golf balls. Principal damage to corn, sorghums, and gardens. Path 10 miles long.
Morland to Penokee, Graham County, Kans.	2	3:45-4:45 p. m.	[1] 6		50,000	Hail and wind	Chief damage from hail. In Morland, 25 percent of windows broken. Hailstones accumulated to depth of 6 inches in places along highway, resulting in heavy fog in which 2 collisions occurred. Feed crops destroyed. Path of storm 8 miles long.
Cass County, Mo.	2	4:30 p. m.	[1] 1		1,500	do	Storm from northeast occurred at Pleasant Hill over area of 1 square mile. Automobile tops, trees, and flowers damaged; some corn blown down. Hailstones $\frac{5}{16}$ to $\frac{3}{4}$ inch in diameter. Crop damage estimated at $1,000, included in total.
Russell County, Kans	2	4:30-7:30 p. m.	[1] 10	1	1,000	Wind, hail, and electrical.	Occurred over strip 30 miles long through Russell. Some damage to crops. 1 man killed by lightning.
Shawnee and Wabaunsee Counties, Kans.	2	11 p. m.	[1] 5		200,000	Hail, wind, and rain	Storm centered near Dover. Reports indicate downpour of 8 to 13 inches of rain. Hail destroyed many acres of corn. Several barns and outbuildings demolished. Severe flooding by Mission Creek and small streams. Damage to highways and bridges, $50,000; to buildings, $50,000; to crops by hail, $100,000.
Glen Lyn (near), Va	3	6 p. m.		2	10,000	Rain	2 persons drowned when sawmill and dwelling washed away.
Inner Canyon and North Rim of Grand Canyon, Ariz.	4	Early afternoon			2,000	Thunderstorm and flash flood	0.80 inch of rain in 55 minutes damaged powerhouse and government installations on North Rim of Grand Canyon and in canyon bottom. Large sections of flume washed away, and creek bottom in several places dammed by rock and mud slides. Power and water supplies disrupted for 2 days.
Umatilla County (near Pendleton and Adams), Oreg.	4	6-9 p. m.			250,000	Hail and electrical	Storm centered near Adams, with hailstones as large as apricots reported. 8,000 acres of wheat largely spoiled; ranchhouse windows broken. Some grass fires started by lightning.
Ismay, Mont	4		[1] 5			Hail	Severe damage to small grains and windowpanes over 30 mile path.
Wickenburg, Ariz	5	6-7 p. m.			100,000	Rain and wind	2.25 inches of rain in 1 hour caused rapid run-off from side washes that run into Hassayampa River. 3 auto courts extensively damaged by water and high winds. Sidewalks washed out; several automobiles covered with silt and boulders. Many trees blown down, damaging roofs and interrupting power and communication lines. Extensive washing of orchards and gardens.
Norris, Mont	6	12:30 p. m.	[1] 1			Hail	Moderate hail, up to size of walnuts, caused considerable damage to wheat.
Scobey (near), Mont	6	4-4:20 p. m.	[1] 4		200,000	do	Severe damage to small grains over path 6 miles long.
Culbertson (near), Mont	6	5-5:10 p. m.	[1] 3		500,000	Hail and wind	In path 10 miles long heavy hail caused severe damage to wheat and $10,000 damage to buildings; winds caused $10,000 damage to property.
Vida, Mont	6	5-5:45 p. m.	[1] 10		1,000,000	Hail	Damage to wheat and flax over path 50 miles long.
Circle (near), Mont	6	6:30-7 p. m.	[1] 12		250,000	Hail and wind	Heavy hail, size of golf balls, caused severe damage to small grains and $1,000 damage to buildings over path 65 miles long. Some farmers reported 100 percent losses to grains. $3,000 damage to property by wind.
Terry (near), Mont	6	8:30-9 p. m.	[1] 4		400,000	Hail	Severe damage to small grains and corn and some damage to buildings over path 35 miles long.
Glendive (near), Mont	6	8:30-8:55 p. m.	[1] 2-6		175,000	do	Heavy hail, some size of hens' eggs, caused considerable damage to small grains over path 9 miles long; about 52 head of cattle severely injured.
Mildred, Mont	6	9-9:30 p. m.				do	Hailstones, size of marbles, caused considerable damage to grains
Westmore, Mont	6	9:30-10 p. m.				do	Considerable damage to wheat.
Capitol, Mont	6	11 p. m.				do	Considerable damage to small grains.
Glasgow (near), Mont	6	P. m.	[1] 20		140,000	do	Damage to small grains over path 50 miles long.
Crown King (near), Ariz	6	Evening	[1] 4		27,000	Electrical, rain, and hail	Rocks and debris on roads northeast of Crown King. Flooded canyons cut main road up to 50 feet wide and 200 feet deep. Population isolated for 3 days. Lightning struck Golden Crown Mining Corporation's main structure. Major damage to mining tunnels and pumps by flooding. Corrals and barns washed out in vicinity of Cleator. Canyons in vicinity of major downpour washed out to bedrock Observer estimated 8 inches of rain in storm center in about 1¼ hours. Telephone and power lines out for several days.
Richey, Mont	6		[1] 5		100,000	Hail and wind	Severe hail damage to wheat over path 100 miles long. High wind caused $10,000 damage to crops and $15,000 damage to property
Opheim (near), Mont	6		[1] 22			Hail	Considerable damage to small grains and gardens over path 40 miles long.
Lodge Grass, Mont	7	4:55-5:30 p. m.	[1] 1		200,000	do	Heavy hail up to 1 inch in diameter damaged wheat and sugarbeets; some damage to gardens and windowpanes.
Miles City (near), Mont	7		[1] 5		100,000	do	Considerable damage to small grains and alfalfa over path 30 miles long.
Opheim (near), Mont	7		[1] ½-6			do	Severe damage to small grains. Hailstones up to size of golf balls. Some farmers suffered 100 percent loss of crops.
Bingham and Bonneville Counties (parts of), Oreg.	8	2-2:30 p. m.	[1] 1-4		100,000	do	Storm travelled northeastward. Severe damage to wheat, potatoes, and hay in path about 20 miles long near Idaho Falls. Hailstones up to 1 inch in diameter.
Capulin, N. Mex	8	2:30 p. m.			2,000	do	Most damage to farm crops.
Malta (near), Mont	8	2:30-3 p. m.	[1] 3-4		90,000	do	Hailstones, up to ¾ inch in diameter, caused severe damage to small grains over path 12 miles long.
Capitol, Mont	8	3 p. m.	[1] 1			do	Considerable to severe damage to small grains. 100 percent loss of unharvested grains in some areas.
Tahoka, Lynn County, Tex	8	4:30 p. m.	[1] 2		110,000	Wind and hail	Most damage to cotton; some to roofs and car tops. Hail damage to crops, $90,000; to other property, $9,000. Wind damage, $11,000.
Spur, Tex	8	6:30 p. m.			5,000	do	Hail damage, $4,000; wind damage, $1,000, mostly to cotton.
Hysham, Mont	8	6-6:20 p. m.	[1] 1½			do	Severe damage to small grains, corn, and sugar beets.
Baker (near), Mont	8	7-7:10 p. m.	[1] 1¼			Hail	Some damage to peas, small grains, and soft-leaf crops.
Oakley (8 miles southeast), Idaho.	9	2 p. m.	[1] 1		35,000	Hail	Struck Lann Ranch, travelling from southwest over path about 3 miles long. "Extra heavy hail, marble size" caused severe damage to hay, peas, grain, corn, and potatoes. "The ground was completely covered with hail and had not melted in the hay until noon next day."
Calvert County, Md	9	4:30 p. m.				do	Farmers reported their tobacco crops a complete loss; amounted to $3,000 at one farm.

SEVERE LOCAL STORMS FOR AUGUST 1948—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Pyote, Ward County, Tex	9	8:20 p. m.	200			Wind	Approximately 90 aircraft damaged. 1 hangar and an unoccupied building damaged.
Rappahannock County, Va	9	8:30-9 p. m.	[1] 1		$29,000	Hail and wind	Apples, peaches, and corn destroyed.
Faribault and Freeborn Counties, Minn.	9	P. m.	[1] 1		100,000	Thundersqualls	A number of barns, outbuildings, silos, and windmills demolished; houses, buildings, and automobiles damaged; trees uprooted or branches broken off: crops in storage and growing crops damaged; signs, poles, and wires down; plate glass windows blown in.
Martin and Faribault Counties, Minn.	9	P. m.	[1] 6		215,000	Hail	Damage in places to growing crops and considerable damage to real property.
Minnesota (extreme south and southeast).	9	P. m.			25,000	Electrical	Several places struck by lightning. At Mankato 3 fires started and considerable damage to power lines. In St. Paul, large chimney was struck and 1 person injured.
Minnesota (extreme south-central).	9-10	P. m.-a. m.			300,000	Rain	Excessively heavy rains that accompanied severe thunderstorms flooded fields, lowlands, highways, roads, streets, and basements. Several small bridges and railroad tracks washed out; much soil erosion; trains delayed by landslides; some turkeys drowned.
Stanton (10 miles south), Stanton County, Nebr.	9-10	11:30 p. m.-2:30 a. m.	[1] 8			Hail and wind	Corn damaged 7 to 56 percent. Much of damage from accompanying gale winds. Path 15 miles long.
Schuyler (north of), Colfax County, Nebr.	10	1:30 a. m.	[1] 2			Wind	Corn stripped by wind and some buildings blown down.
North Topeka, Kans	10	8:58-9:15 a. m.	900		10,000	do	Several buildings suffered minor damage. Power and telephone lines blown down. Much damage to shade trees. One tree fell across a parked automobile.
Douglas, Ariz	10	2:30 p. m.			4,000	Rain and hail	Main part of town flooded. Water poured into hotels, banks, and offices. Ditches and streets washed badly. Some hail damage to roofs.
New London (1 mile north and 3 miles west), Wis.	10	3:30 p. m.	[1] 1		10,100	Hail and electrical	Hailstones up to 2 inches in diameter. $10,000 loss to crops and $100 to buildings.
Dodgeville (near), Wis	10	Afternoon			500	do	Hail damage to crops
Winchester, Omro, and Poygan Townships, Winnebago County, Wis.	10	4:30-6 p. m.	[1] 5		5,000	do	Crop damage, $3,000; 2 wooden silos destroyed, $2,000.
Bozeman (near), Mont	10	5-5:20 p. m.	[1] 2-3		25,000	Hail	Considerable damage over path 10 miles long. Small grains damaged.
Wayne County, Nebr	10	5:30-8:30 p. m.	[1] 6		35,000	Hail and electrical	Damage of about $15,000 to corn and other crops, and $20,000 to buildings, including barn burned from lightning. Path 6 miles long.
Baltimore County, Md	10	P. m.				Hail	Hailstones, some 3 inches in diameter, fell in areas around Fullerton, Perry Hall, and Chase, tearing leaves from trees and damaging crops.
Genoa, Platte County, Nebr.	10		[1] 5			Wind	Corn stripped, and threshing machines, hay rakes, and a few barns, and windmills damaged.
Parkersburg, W. Va	11	5-6:20 a. m.				Electrical	2 residences struck by lightning; damage by fire in one and to radio and wiring in other.
Scribner and vicinity, Dodge County, Nebr.	11	12:30 p. m.	[1] 2		75,000	Hail and wind	Damage to crops; corn stripped. Path 6 miles long.
Culbertson, Mont	11	3:30-3:40 p. m.	880		5,000	Hail	Damage to wheat over path 3 miles long.
Redwillow and Hitchcock Counties, Nebr.	11	4-4:30 p. m.	[1] 1		65,000	do	Corn and alfalfa damaged, about $30,000, and other property, about $25,500, in Hitchcock County over a path 6 miles long.
Bozeman (near), Mont	11	5:30-6 p. m.	[1] 1½		20,000	do	Considerable damage to small grains over path 14 miles long.
Ness County, Kans	11	8-9 p. m.	[1] 3-18		175,000	Wind and hail	Path from 3 miles north of Brownell to south of Bazine. Wind damage about $75,000, mostly to barns and sheds in or near Brownell. Hail damage to crops, $100,000.
Chambersburg, Pa	11	Afternoon			8,000	Electrical	A barn, nearby buildings, feed, and implements destroyed by lightning.
Allen County, Ohio	11					Hail	Some damage to crops, especially corn.
Weleetka, Okfuskee County, Okla.	11			1		Electrical	Killed girl, knocking another unconscious.
Ponca City, Kay County, and Vinita, Craig County, Okla.	12	12:30-1:45 a. m.			5,000	Electrical and wind	Lightning struck 2 houses; burned one to ground, caused $500 damage to another. Power and telephone lines struck, disrupting service.
Sumner County, Kans	12	12:30 a. m.	[1] 12		20,000	Wind	From northwestern part of county to Anson; high winds at Wellington. Farm buildings wrecked or damaged.
St. Louis County, Mo	12	12:10 p. m.	880		11,200	Wind and hail	Storm from west struck Sylvan Beach Airport; 1 hangar blown down and another damaged; 7 airplanes damaged.
Farmville, Va	12	9-9:30 p. m.	[1] 1¼		30,000	do	Tobacco, corn, and some hay destroyed 4 miles northeast of Farmville and in southern Cumberland and northeastern Prince Edward Counties. Damage heaviest to early tobacco.
Hagerstown, Md	12	P. m.		1		Thunderstorm	Lightning fire destroyed a home, causing death of girl from burns.
Valentine, Nebr	12	Night				Hail and wind	Considerable damage to corn in surrounding area; some windows broken.
Beaver Dam, Va	12				8,000	do	Tobacco destroyed. Chimneys and outbuildings blown down.
Frederick County, Va	12				30,000	Hail	In Timber Ridge area apple and peach orchards badly damaged.
Estherville, Emmet County, Iowa.	13	4-4:25 a. m.				do	A number of corn fields west and north of Estherville stripped. Some high winds. Damage small.
Opheim, Mont	13	3-3:20 p. m.	[1] 8		200,000	do	Considerable damage to wheat and barley over path 8 miles long.
Scenic and Imlay, Pennington County, S. Dak.	13	3:30-4 p. m.				Rain and hail	Washed out railroad track; damaged buildings and grain.
Brewster, Florence, and Penrose, Colo.	13	4:05-4:45 p. m.	[1] 4		450,000	Hail	Hailstones, size of marbles, damaged truck crops, such as cabbage, celery, tomatoes, berries, and apples, in path 15 miles long. Some damage to roofs and windows.
Dalhart, Hartley County, Tex.	13	6:30 p. m.	[1] 2		15,000	do	Hailstones about size of golf balls. Most of damage to buildings.
South Coventry and vicinity, Conn.	13	Late afternoon			15,000	Electrical	3 large barns and 4 other buildings damaged by lightning.
Franklin, Hampshire and Hampden Counties, Mass.	13	Midafternoon				Electrical and hail	Serious tobacco plant damage by large hailstones in Connecticut Valley. 25 houses struck by lightning.
Cranston and Pawtuxet Valley, R. I.	13	Late afternoon			2,000	Electrical	Local damage to electrical control equipment. Lightning struck a church and 2 homes.
Glendive (near), Mont	13					Hail	Severe damage to small grains; from 25 to 100 percent loss.
Malta (near), Mont	13		[1] 1		3,500	do	Considerable damage to a small acreage of wheat.
Miles City (near), Mont	13		[1] 2½		50,000	do	Considerable damage to small grains and alfalfa over path 16 miles long.
Rapid City, S. Dak	13				100,000	Wind and rain	Severe thunderstorm damaged hangar at Army airport. Light and power lines blown down. Maximum wind of 60 m. p. h. broke previous records for August.
Antelope County (western portion), Nebr.	14	2 p. m.	[1] 3			Hail	Hailstones, 1¼ to 2½ inches in diameter, killed small pigs, poultry, stripped corn stalks, and matted down meadows. Heavy damage to tops of autos and roofs. Path 22 miles long. Damage severe.
Plymouth, Sioux, and Cherokee Counties, Iowa.	14	Late afternoon and evening.				do	About 800 Plymouth County farms damaged; northeast corner of Meadow Township bore the brunt of storm. Extensive damage in southeastern Sioux County and near Marcus in Cherokee County. Hailstones small, damaging soybeans more severely than corn; losses varied from negligible to 70 percent.
Vicksburg, Miss	15	9 p. m.				Thunderstorm	Severe thunderstorm developed on a squall line, resulting in winds up to 60 m. p. h. in gusts. Damage confined to trees, awnings, signs, power and communications lines. Tent collapsed upon people at religious meeting. Damage considerable.

SEVERE LOCAL STORMS FOR AUGUST 1948—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Jacksonville, Fla.	15	Late afternoon		1	$20,000	Electrical and wind.	1 person killed by coming in contact with fallen high tension wire. Wind in gusts up to 50 m. p. h. at Naval Air Station. Damage to city electrical equipment $15,000, mostly due to lightning. 11 fires caused by lightning, including loss of residence valued at $5,500.
Pine Bluff, Ark.	15	Afternoon			10,000	Rain and wind.	1.4 inches of rain in 35 minutes caused general overflow of curbs. wall and roof of auto company caved in, damaging several cars; Winds damaged some roofs and disrupted several power lines.
Glasgow (near), Mont.	16	12-12:20 a. m.	[1] 2-4		1,000,000	Hail and wind.	Hail damaged small grains over path 60 miles long. Some wind damage to buildings.
Vineland (6 miles northwest of Oshkosh), Wis.	16	4:45-5:30 a. m.			15,000	Electrical and wind.	2 barns, a granary, corn crib, tool house, hog shed, 17 tons of hay, and 2,000 bushels of oats destroyed by lightning fire.
Waukesha (near), Wis.	16	1:30-2 p. m.	[1] 2		10,000	Hail.	Hailstones, ¼ to 2 inches in diameter, damaged crops; about 800 acres damaged.
Port Lavaca, Calhoun County, Tex.	16	4 p. m.	[1] 4		25,500	Wind.	Damage to 3 windmills. Greatest damage, $25,000, to cotton.
Baylor (near), Mont.	16	4:45-5 p. m.			700,000	Hail.	Damage to small grains; 100 percent losses in some areas. 1 to 4 inches of hail found on level ground.
Sharon (near), Wis.	16	4:45-6 p. m.	[1] 10		151,000	Electrical, hail, and wind.	Path 10 miles long; only major hail loss in rural section of Sharon in its history. Hailstones as large as baseballs reported. Barns and smaller buildings moved off foundations, silos blown down, roofs removed or perforated, hundreds of windows broken, poultry killed. Telephone and electrical lines damaged. Estimated loss to buildings, equipment, etc., $50,000; to poultry, $1,000; to crops, mainly corn, $100,000.
Elkader and Garber, Clayton County, Iowa.	16	Afternoon	[1] 2			Hail.	Sudden hailstorm, with stones as large as hens' eggs, caused variable destruction from near Elkader southward to Garber.
Harvard, McHenry County, Ill.	16	5 p. m.	[1] 3			Hail and wind.	Several cornfields damaged by hailstones, averaging ¾ inch in diameter.
Burlington and Walworth, Wis.	16	5:50-6:10 p. m.	[1] 2		21,100	Electrical, hail, and wind.	Heavy hail, ½ to 2 inches in diameter. Many trees uprooted and broken; electric and telephone wires torn down. Small church steeple at Burlington crashed through slate roof of church. Many basements flooded. Estimated loss to crops, mainly corn, $15,100; to buildings, equipment, etc., $6,000.
Culbertson, Mont.	16	6:30-6:45 p. m.	[1] 2		400,000	Hail and wind.	Heavy hail caused severe damage to wheat and buildings over path 85 miles long. Winds caused $15,000 damage to crops and property.
Lustre (near), Mont.	16	7 p. m.			200,000	do.	Heavy hail caused severe damage to grains. "Unable to tell what grain had been growing in some fields."
Sargent and Richland Counties, N. Dak.	16	Late evening	[1] 10		25,000	Wind.	Small buildings damaged; crop damage estimated at $10,000, included in total. Major damage in Lidgerwood and vicinity.
Wheaton and vicinity, Minn.	17	12:10 a. m.	[1] 20		150,000	Thundersqualls and hail.	A number of buildings demolished, moved from foundations, or otherwise damaged; hundreds of trees uprooted or branches broken off; communication and power lines disrupted; farm machinery damaged; haystacks scattered. Grain in shocks and growing crops damaged by light to heavy hail.
Minneapolis-St. Paul and vicinity, Minn.	17	2:40 a. m.			2,000	Electrical.	A number of places struck by lightning; one injury.
Manawa, Wis.	17	Early a. m.			1,000	Hail.	Damage to crops, mostly corn.
Whiteside County, Ill.	17	4 p. m.	[1] 3-6		2,000,000	do.	Damage to crops, orchards, gardens, poultry, and farm buildings. Many cornfields and gardens total loss. Many windows broken and greenhouses severely damaged. Several hundred chickens killed by hail; some hailstones reported to be as large as baseballs.
Iowa (extreme eastern portion).	17	Late afternoon				Hail and wind.	Storm struck a number of local communities in Clinton, Muscatine, Scott, and Jackson Counties, then moved into western Illinois. Strong wind between Muscatine and Davenport toppled numerous utility poles. Except in a few small local areas, crop damage estimated to be light.
Northern Warren County and Southern Mercer County, Ill.	17	5:45 p. m.	[1] 1	0	1,500,000	Tornado and hail.	Very heavy damage to corn and soybeans by hail. Several cars damaged and many windows broken. 10 farm homes practically ruined by tornado; a few minor injuries.
Scales Mound, Jo Daviess County, Ill.	17	5:50 p. m.	[1] 1		3,000	Hail.	Cornfields damaged.
Ogle County, Ill.	17	5:50 p. m.	[1] 15		66,000	Hail and wind.	Heavy damage to corn and soybeans by hailstones, averaging 1 inch in diameter and some as large as 3 inches in diameter. A few buildings unroofed and some poultry loss.
Lee County (northern and eastern portions), Ill.	17	6 p. m.	[1] 5		1,000,000	Hail.	Corn and soybeans seriously damaged by hailstones, averaging size of walnuts, with some stones reported as large as baseballs. Many roofs damaged; many windows broken, and automobiles dented.
Olsburg to Belvue, Pottawatomie County, Kans.	17	6:30 p. m.	[1] 2		250,000	Wind and hail.	Barns and other farm buildings blown down. Hail damaged crops extensively.
LaSalle County, Ill.	17	6:30 p. m.	[1] 3½		1,000,000	Hail.	Crops, mainly corn and soybeans, damaged by hailstones, ranging up to 2½ inches in diameter. Many windows shattered.
Lanark, Carroll County, Ill.	17	6:45 p. m.	[1] 3		15,000	do.	Considerable damage to corn, hay, and gardens by hailstones size of walnuts. A greenhouse heavily damaged.
Outagamie County, Wis.	17	7:50-8:50 p. m.			5,600	Electrical and wind.	5 places struck by lightning within 5-minute period. Wind more severe in Hortonville-New London area. Power poles felled and 2 cattle killed 6 miles southwest of Darboy, valued at $600. Property damage in Appleton estimated at $4,000. Damage to utility lines in Outagamie County, $1,000.
Grundy County, Ill.	17	8:30 p. m.	[1] 3		47,500	Hail.	Greatest loss to corn and soybeans. Some roofs and windows damaged. A large number of birds killed.
Owaneco, Christian County, Ill.	17	9 p. m.	[1] 3			do.	Considerable damage to crops, mainly corn.
Pittsylvania County, Va.	19	11 a. m.			25,000	Hail and wind.	Principal damage to tobacco near Rondo, Weal, and Shockoe communities.
Lunenburg, Hanover, and Mathews Counties, Va.	19	Late afternoon				Hail.	Tobacco and corn damaged heavily in some areas.
Stark County, Ohio.	19	Late afternoon				Rain and electrical.	In Canton 2.28 inches of rain in 2 hours flooded streets, and public utility lines were damaged by lightning. Corn damaged by washing and flooding, especially along creeks.
Glasgow (near), Mont.	19	6-6:17 p. m.	[1] 2-6		1,000,000	Hail.	Damage to small grains over path 50 miles long.
Aiken, S. C.	19	Night			3,000	Electrical, wind, rain, and hail.	Grain filled stable destroyed by lightning fire. Storm accompanied by high winds, heavy rain, and hail. Plate glass windows broken in several stores, traffic blocked, and power interrupted.
Leonardtown, Md.	19	P. m.		2		Wind and thunderstorm.	High winds capsized a boat with 5 fisherman; 2 drowned.
Miles City (near), Mont.	19		[1] 3		50,000	Hail.	Damage to small grains over path 8 miles long.
Tampa, Fla.	19			0	0	Waterspout.	
Charleston, S. C.	21	10:30 a. m.		1		Electrical.	1 person killed by lightning.
Baltimore, Md.	21	P. m.				Rain.	Parts of eastern Baltimore heavily flooded. Sidewalks and roads washed away; some cellars flooded as deep as 6 feet.
Libertytown and vicinity, Md.	22	3:39 p. m.	[1] 1			Hail.	Hailstones, some 2½ inches in diameter, caused considerable damage in path 5 miles long in and south of Libertytown. Reported that hail collected to a depth of 6 inches. Garden crops, about 65,000 bushels of apples and about 25 acres of tomatoes and truck crops a complete loss. Buildings with paper or shingle roofs completely ruined.

SEVERE LOCAL STORMS FOR AUGUST 1948—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Lancaster (east of), Pa.	22					Hail	Approximately 500 acres of tobacco damaged.
Baylor (near), Mont.	23	4-6 p. m.	[1] 3		$150,000	do	Damage to small grains, potatoes, and gardens over path 25 miles long.
Big Sandy, Mont.	23	5:05-5:15 p. m.	[1] 2			do	Considerable damage to small grains over path 15 miles long.
Havre, Mont.	23	5:35-5:42 p. m.		1		Wind	Strong gust of wind jarred house being moved, and one of rollers crushed boy.
Bruce (5 miles northeast), Rusk County, Wis.	25	4 p. m.	[1] 1		1,000	Electrical, hail and wind.	A small girl lifted and buffeted about by the storm but not injured.
Wheaton (near), Barry County, Mo.	25			1		Electrical	Man killed by lightning while plowing in field.
Atoka (15 miles north), Coal County, Okla.	25			1		do	Man killed by lightning in field.
Goodwell, Texas County, Okla.	26	8:00-9:30 p. m.			20,000	Electrical and hail	Lightning destroyed large storage building at Panhandle A&M College; damage estimated at $15,000. 2 persons injured. Small area of irrigated gardens between Goodwell and Guymon completely destroyed by hail.
Plymouth and Cherokee Counties, Iowa.	27	Evening				Rain	At Remsen in northeast Plymouth County 5.70 inches of rain fell within a few hours. At Cherokee, 3 inches fell within 2 hours and a total of 4.15 inches reported for storm. Rivers and creeks went out of banks; many basements flooded in Storm Lake, Remsen, and Cherokee. Crops damaged in low areas.
Hawley and vicinity, Pa.	28		[1] 1			Electrical and wind.	Winds blew down many trees; damaged electric and telephone lines. Lightning caused several fires; killed 1 cow. Boy slightly injured when tree limb fell on car.
Bruce (10 miles south) and Ladysmith, Rusk County, Wis.	28	6:30 to 10 p. m.	[1] 12	1	6,000	Electrical, hail and wind.	1 man killed by lightning while working on farm and 1 injured; 6 cows knocked down. Lightning struck power lines and several buildings.
Pelican Lake, Oneida County, Wis.	28		[1] 1	1		Wind	Man drowned in Pelican Lake when boat swamped.
Marion (near), Wis.	28				4,000	Electrical	Barn struck by lightning and burned.
Faribault, Olmsted, and Winona Counties, Minn.	29	A. m.—p. m.	[1] 1		44,000	Hail	Hail, accompanying a severe thunderstorm, damaged growing crops and some real property.
Critz, Va.	29	1-1:30 p. m.	[1] 1		8,650	Hail, wind, and electrical.	Tobacco destroyed. 1 horse killed by lightning.
Olmsted and Winona Counties, Minn.	29	2:40-7 p. m.			79,000	Thundersqualls (possibly small tornado).	Several Winona County fair buildings wrecked and others damaged; 100-foot church steeple toppled; a number of barns, outbuildings, garages, silos, and windmills demolished; many barns, houses, buildings, and farm machinery damaged; poles, wires, and signboards down; many trees uprooted; hay and straw stacks scattered; motorcycle blow off road and driver seriously injured; about 25 head of livestock perished; growing crops damaged. Path of storm about 7 miles long and in southeasterly direction. (See following report).
Fountain City, Wis.	29	3:30-5:30 p. m.	[1] 4	37		Electrical, hail, and wind.	Thunderstorm continued from Minnesota. Hailstones about ½ to 2 inches in diameter. During the storm a Northwestern Airlines airplane crashed on the bank of the Mississippi River northwest of Winona with loss of 37 lives.
Vernon and Crawford Counties, Wis.	29	4-8:30 p. m.	[1] 5-10		250,500	do	About 1,000 farmers in western Vernon and northern Crawford Counties suffered heaviest crop losses in history, especially to tobacco and corn; townships of Bergen, Hamburg, Genoa, Wheatland, and Harmony, and parts of Clinton, Webster, Jefferson, Liberty, Sterling, and Franklin had heaviest hail losses of record. Hailstones at Genoa as large as small oranges. Hides of livestock slashed by hail; chickens killed; many roofs punctured; automobile bodies, especially tops, dented. Losses in Vernon County: tobacco and corn, $50,000; barns burned with hay and grain, $20,000; poultry $500; buildings and machinery, $40,000. Losses in Crawford County, $140,000.
Adams County, Ohio.	29	4-4:30 p. m.				Rain and electrical.	Barn struck by lightning. Roads north and west of Pebbles flooded.
Syracuse and vicinity, N. Y.	29	4:30 p. m.				Electrical and wind.	Houses struck by lightning; wires torn from telephone and electric poles; persons marooned in cars, due to live wires as well as branches and fallen trees blocking streets and highways. Wind velocities up to 50 m. p. h.
Shawneetown, Gallatin County, Ill.	29	5 p. m.			35,000	Electrical	Lightning fire destroyed 3 oil tanks and 4,000 barrels of oil. A few miles away a large barn filled with harvested crops also destroyed by lightning.
La Crosse County, Wis.	29	5:50-6:30 p. m.	[1] 10		110,000	Electrical, hail, and wind.	Heavy damage to corn and tobacco in area, extending from Genoa to Viola; loss estimated at $100,000. Automobile tops damaged by hail; loss estimated at $10,000.
Winona County, Minn.	29	6 p. m.			1,000	Electrical	A number of places struck by lightning; 2 boys injured in barn; church in Lewiston damaged by fire after steeple was struck.
Hanover County, Va.	29	7-8 p. m.			5,000	Hail	Tobacco and late corn damaged in scattered areas.
Scott County, Va.	29	7-8:30 p. m.	[1] 3		9,000	Hail and wind	Much tobacco and corn destroyed at Nickelsville and in Big Moccasin Valley.
Chilhowie (4 miles southeast), Va.	29	7:30-8 p. m.	[1] 1		20,000	Hail	Apples, corn, and burley tobacco damaged.
Farmville (6 miles east), Va.	29	8-8:20 p. m.	880		10,200	Hail, wind, and electrical.	Tobacco seriously damaged. 2 buildings destroyed by lightning fire. Several buildings demolished by wind.
Carroll County, Ill.	29	8:40 p. m.	[1] 10		500,000	Hail and wind	Corn, soybeans, and watermelons suffered heavy damage. Several barns and small buildings wrecked by high winds, a large number of windows broken, and many buildings unroofed. 4 planes at the Savanna airport damaged. Power and telephone services badly hit. Heavy property loss at Mt. Carroll, Savanna, Thomson, Chadwick, and Lanark.
Whiteside County, Ill.	29	9:30 p. m.			500,000	do	Most of damage by winds up to 85 m. p. h. Corn flattened; some buildings wrecked and many others lost their roofs. A hangar at Sterling Airport wrecked and 3 planes badly damaged. Power and telephone services crippled. Heaviest damage in Sterling area, but Morrison also hit.
Wytheville (near), Va.	29	P. m.			12,000	do	In Mt. Pleasant and Fairview Sections. Most damage to corn and apples; some windows broken and slight damage to roofs.
Iowa (extreme eastern portion).	29-30	Night			20,000	Wind and electrical.	Hardest hit were cities along the Mississippi River in the quad-city area, and Clinton. Line of thunderstorms reached their maximum intensity as they struck eastern Iowa. At Clinton Airport wind estimated at 75 m. p. h. in gusts; at Moline Airport wind measured at 50 m. p. h. with gusts to 80 m. p. h. Storm damage general in Clinton and Davenport, with broken trees, toppled power and telephone lines, and minor property damage. Lightning struck depot in Bettendorf, resulting in $5,000 fire.
Columbia, S. C.	30	2:30-4:30 p. m.			50,000	Thunderstorm	A rather severe thunderstorm, with moderate hail and high winds. 1 person slightly injured.
Belleville (near), W. Va.	30	5-8 p. m.				Electrical	Barn struck by lightning, causing total loss, valuable horse killed by stroke; man standing next to horse seriously injured whe horse fell upon him.
Chambersburg, Pa.	30				2,500	Wind	Wind damaged 2 crop-spraying planes at airport; blew out section of hangar wall.
Gallipolis (near), Gallia County, Ohio.	30					Electrical	2 barns destroyed by lightning fire.
Forrest City and vicinity, Ark.	30	Evening			25,000	Wind	Widespread damage to roofs, power lines, windows, and tree Major portion of damage occurred when roof from a stock auction barn settled on store.

[1] Miles instead of yards.

LATE STORM REPORTS FOR JULY 1948

[The table hereunder contains such data as were received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Roundup (near), Mont	1	4-4:30 p. m.	[1] 1¼			Hail	Hailstones, size of peas, caused considerable damage to wheat.
Stanford, Mont	1	6-6:30 p. m.	880		$2,000	do	Damage to wheat and barley.
Ryegate, Mont	1		440-880			do	Up to 90 percent damage to 500 acres of wheat; some hay fields damaged.
Busby (near), Mont	2	3-3:05 p. m.	[1] 5		10,000	do	Hailstones, approximately size of walnuts, damaged wheat and alfalfa in path 10 miles long.
Plevna, Mont	3	7-7:15 p. m.	[1] 4		80,000	do	Severe damage to wheat, barley, and flax in a path 14 miles long. Paint on dwellings also damaged.
Wibaux, Mont	3	6 p. m.	[1] 3			do	Hailstones, size of hens' eggs, caused severe damage to small grains in path about 6 miles long. Storm from northwest circled to northeast and then returned in a westerly direction.
Busby, Mont	3	4:30 p. m.	[1] 5			do	Hailstones, some as large as hens' eggs, caused severe damage to small grains over path 12 miles long. Hundreds of windows broken. Gardens, roofs, and shrubbery damaged.
Emory (near), Mont	3	4-4:30 p. m.	[1] 2			do	Considerable damage to wheat; $50 property damage.
Richey, Mont	6					do	Moderate hail caused some damage to wheat and barley.
Poplar (near), Mont	6	4-4:30 p. m.	[1] 2			do	30 percent loss to approximately 2,000 acres of wheat.
Richey, Mont	7	6:30-7 p. m.			18,000	do	Considerable damage to wheat; $500 property loss.
Malta (near), Mont	7	P. m.	[1] 1½-2		50,000	do	Damage to small grains over path 15 miles long.
Turner, Mont	7	4:30-4:50 p. m.	[1] 2-3		25,000	do	Damage to small grains over path about 6 miles long.
McCone County, Mont	7 and 14					do	300 acres of wheat completely lost. Most farms in Township 16, Range 49 reported from 10 to 90 percent loss.
Baker (near), Mont	9	4-4:10 p. m.	[1] 1			do	Moderate hail, size of marbles, caused considerable damage to flax, alfalfa, and range grass. 50 percent loss to 200 acres of flax.
Talbotton (near), Ga	9	Midafternoon	200-300	0	4,000	Tornado	Storm moved down valley section of Talbot County near Talbotton. 1 home heavily damaged; another slightly damaged; moderate to heavy damages to 10 tenant houses.
Circle (near), Mont	10	9-11 p. m.				Hail	10 to 20 percent loss to some wheat fields.
Miles City, Mont	10		[1] 5		60,000	do	Hailstones, up to 1 inch in diameter, damaged small grains severely over path 18 miles long. $3,000 loss to buildings.
Miles City (near), Mont	10				80,000	do	Hailstones, up to 1 inch in diameter, damaged crops and buildings severely over path 12 miles long. $2,000 loss to buildings.
Martinsdale (near), Mont	10	6-7 p. m.	176	0	8,000	Tornado, electrical, rain, and hail.	1 house totally destroyed, 14 head of cattle killed by lightning. Hail washed by rain "looked like a winter snowbank." Hailstones up to 1 inch in diameter.
Utica (near), Mont	10	5-6 p. m.				Hail	Heavy hail, with stones as large as walnuts, caused severe damage to small grains.
Columbus, Mont	10	4-4:10 p. m.	[1] 1½			do	Considerable damage to small grains by light hail over path 3 miles long.
Shawmut (near), Mont	10	7:30-8:15 p. m.	[1] 3			Hail	Heavy hail, some as large as hens' eggs, caused severe damage to small grains and buildings.
Geraldine, Mont	11		[1] 3		50,000	do	Hailstones, up to 1 inch in diameter, damaged wheat and barley over a path 20 miles long.
Lustre, Mont	11	10:15 p. m.			15,000	Hail and wind	Hail damaged small grains. Wind caused $300 damage to a barn.
Malta, Mont	11	6-6:45 p. m.				Hail and rain	Considerable hail damage to small grains in some areas.
Bozeman (near), Mont	11	4:30-5 p. m.	[1] 2-3		7,500	Hail	Damage to peas and wheat in small areas.
Cleveland (near), Mont	11	4:30-5:15 p. m.	[1] 1½		4,500	do	Damage to wheat in small area.
Dillon, Mont	11	2:30-2:40 p. m.	[1] 2		5,000	do	Damage to peas and winter wheat over path 10 miles long,
Terry (near), Mont	11-12	5-5:25 p. m. 11-11:25 p. m.	[1] 2		155,000	Hail and wind	Storms on 2 days over approximately the same area 25 to 50 miles long. Wind caused damage of $5,000 to buildings and $50,000 to small grains.
Glendive, Mont	12		[1] 5-6		70,000	Hail	Hailstones, some as large as billiard balls, damaged small grains and flax.
Stanford, Mont	13	3-3:20 a. m.	[1] 1		60,000	do	Damage to spring and winter wheat.
Powder River County, Mont.	13		[1] 4		80,000	do	Hailstones, up to 1 inch in diameter, damaged small grains and tame hay over path 20 miles long.
Glendive (near), Mont	13	7:30-7:50 p. m.			15,000	do	Damage to small grains.
Forsyth, Mont	13	5-6 p. m.	[1] 2		70,000	Wind and hail	$20,000 wind damage and $50,000 hail damage to small grains.
Shelby (near), Mont	14	5:30-7 p. m.	880			Hail	Severe damage to mustard over path 2 miles long.
Vay (near), Idaho	18	Evening				Hail and rain	Garden crops and grain badly damaged or completely destroyed in Vay and Woodfairie districts. 6-inch layer of hail reported next morning. Heavy rain caused 6-inch rivulets on hillsides.
Helena, Mont	19	11:18-11:23 a. m.	[1] 10		500,000	Hail	Damage to buildings and small grains. Most of damage to windows and roofs of buildings and to greenhouses.
Whitehall to Three Forks, Mont.	19	1-1:30 p. m.	[1] 3-6	1	50,000	Tornado, electrical, and hail.	Severe hail damage to small grains and buildings over entire area of southern Jefferson County and into Gallatin County as far as Three Forks, where tornado and severe electrical storm developed. Hailstones 1½ inches in diameter, and one measured 5½ inches in circumference. A woman near Three Forks struck by lightning and killed while fishing.
Columbus, Mont	19	P. m.	[1] 2		7,500	Hail	Damage to winter wheat and tame hay over path 25 miles long.
Clydepark, Mont	19	4-4:15 p. m.				do	Heavy hail up to 1 inch in diameter caused severe damage to wheat and buildings.
Lennep to Harlowton, Mont.	19	3-3:30 p. m.	[1] 3		150,000	do	Complete destruction to small grains and severe damage to hay over path 40 miles long. Hay and grain lodged.
Butte (near), Mont	19	12:55-1:10 p. m.	[1] 5		110,000	do	Heavy hail, some as large as golf balls, damaged buildings and gardens over path 10 miles long.
Monarch (near), Mont	19					do	Heavy hail, some as large as turkeys' eggs, caused severe damage to grains and buildings.
Stanford, Mont	19	2:15-3 p. m.	[1] 4		400,000	Hail	Heavy hail, some as large as hens' eggs, caused severe damage to small grains over path 18 miles long. $75,000 damage to buildings alone at Stanford. Almost every west window in every building in town was broken.
Powell and Deer Lodge Counties, Mont.	19	10:30-10:55 a. m.	[1] 8-9		150,000	do	Damage to 500 acres of potatoes and 1,000 acres of wheat.
Ennis, Mont	19	2:30-2:40 p. m.	[1] 3			do	Considerable damage to small grains and hay.

[1] Miles instead of yards.

LATE STORM REPORTS FOR JULY 1948—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Southeastern Rock and Southwestern Nobles Counties, Minn.	20	3:30 p. m.	[1] 2½		$22,500	Hail and rain	Severe thunderstorm moved northeastward, with light to heavy hail, sometimes as large as golf balls, in path 10 miles long. Damage to growing crops, mostly small grains. Additional damage by heavy rain.
Plevna, Mont.	20	6:30-6:45 p. m.	[1] 1-3			Hail	Damage to peas over path 8 miles long.
Loma (near), Mont.	20	P. m.				Rain	Flash flood washed out railroad bridge.
Ekalaka, Mont.	20	Late p. m.	[1] 8-10			Hail	Considerable damage to grains and buildings over path 30 to 40 miles long.
Martinsdale, Mont.	21	P. m.				Hail and rain	Hail damaged hay, grain, and potatoes; on the following morning hailstones still in ditches. 0.68 inches of rain reported in 20 minutes.
White Sulphur Springs, Mont.	21	6:30-6:50 p. m.	[1] 10		20,000	Hail	Damage to small grains and hay.
Great Falls, Mont.	23					Wind and electrical	63 m. p. h. maximum winds damaged trees and roofs. 1 home struck by lightning, tearing hole in roof and another hole in front wall. Some electrical equipment also damaged.
Dawson, Ga.	24	1:30 p. m.	25-50	0	5,500	Tornado	Storm moved north-northeastward and was reported to have traveled no more than about 900 feet. Damage only in industrial area. A cotton oil mill unroofed; top of water tank twisted and left dangling. Several roofs damaged, including the railroad depot and some smaller structures.
Columbus (near), Mont.	24		880		5,000	Hail	Damage to wheat over path 8 miles long.
Culbertson, Mont.	24	3-3:20 p. m.	1,320		18,000	Hail and wind	Heavy hail damaged wheat over path 8 miles long. Storm apparently continued into North Dakota. $2,000 wind damage to wheat.
Hill County, Mont.	27	5-7:30 p. m.			525,000	do	Heavy hail in small area caused 50 to 75 percent loss to small grains. Wind destruction estimated at $500,000 to small grains.
Chester (near), Mont.	27	4:30 p. m.	[1] 2			do	A little hail damage to wheat. Wind caused 25 percent loss of wheat over path 10 miles long.
Chester (near), Mont.	28		[1] 1			do	A little hail damage over path 5 miles long. Wind caused 25 percent loss to small grains.
Bozeman (near), Mont.	29	2:30-2:45 p. m.	[1] 1		2,500	Hail	Damage to wheat over path about 5 miles long.
Powder River County, Mont.	29		[1] 4½		90,000	do	Heavy hail, ½ to 1 inch in diameter, damaged small grains, hay, and rangeland over path 50 miles long. Some buildings damaged.
Bozeman (near), Mont.	31	4-4:20 p. m.	[1] 2		75,000	do	Damage to small grains in small area.
Philipsburg, Mont.	31	7-7:30 p. m.	[1] 10		30,000	Hail and wind	Moderate hail and wind damaged small grains, hay and range grass.
Near Gaia Creek and Helmville, Mont.	31	7-7:10 p. m.	800		5,000	Hail	Damage to small grains over path 15 miles long.
Dillon, Mont.	31	12-12:30 p. m.	[1] 5		5,000	do	Hailstones, up to 1 inch in diameter, damaged peas and buildings.

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR AUGUST 1948

[Solar Radiation Investigation Section, I. F. HAND in Charge]

Explanation of Tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, vol. 72, No. 1, January 1944, p. 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in Table 1 appears in vol. 75, No. 3, March 1947, p. 47.

TABLE 1.—*Solar radiation intensities during August 1948*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]

MADISON, WIS.

	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
August	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
2	0.74	0.86	0.98	1.13	1.27					13.715	11.818
4	.68	.77	.94	1.11	1.37	1.02				13.206	9.076
5	.69	.81	.90	1.07	1.29	1.06	.88			11.378	9.414
6	.70	.80	.92	1.07						11.378	11.818
12	.75	.84	.99	1.14	1.30					16.458	16.458
14		.53	.91	1.01	1.29					13.206	12.258
18	.73	.83	.95	1.11						17.034	15.848
19	.64	.75	.90	1.08	1.25					14.764	15.848
20		.53	.71	.92	1.14					13.206	15.848
24		.49	.66	.88	1.19					25.906	22.588
25		.59	.74	.94	1.23					20.352	19.642
31		.76	.90	1.04	1.23					12.258	15.848
Means	.70	.71	.88	1.04	1.26	(1.04)	(.88)				
Departures	+.05	−.04	.00	−.02	−.04	−.01	−.01				

LINCOLN, NEBR.

	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
August	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
4					1.33					14.58	15.31
10					1.29	0.94	0.69	0.54	0.45	18.29	20.35
16					1.32	1.03	.84	.71	.60	21.07	24.18
18				1.03	1.34	1.06	.88			18.96	15.31
21					1.29	.88				16.94	17.67
23			0.69	.92	1.23	.84	.62	.48		20.35	17.67
24			.75	.97	1.24	.88	.69	.54	.43	21.81	20.35
25			.73	.92	1.15					21.81	18.96
28					1.25	1.03				23.37	22.59
30					1.26	.97	.77	.64	.52	19.64	19.64
31			.86	1.03	1.26	.90	.82	.67	.56	19.64	20.35
Means			.76	.97	1.27	.95	.76	.60	.51		
Departures			−.14	−.11	−.04	−.10	−.10	−.13	−.11		

TABLE 1.—*Solar radiation intensities during August 1948*—Con.

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]

TABLE MOUNTAIN, CALIF.

	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
August	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1				1.36							
5				1.45							
8				1.46							
9				1.43							
10				1.45							
11	1.16	1.25	1.35	1.48							
12				1.46							
13				1.46							
14				1.47							
15				1.46							
16				1.43							
18				1.44							
19				1.46							
23				1.46							
24				1.46							
25				1.39							
26				1.37							
27				1.42							
29				1.37							
Means	(1.16)	(1.25)	(1.35)	1.44							
Departures	+.03	+.03	+.04	+.04							

BOSTON, MASS.

	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	3.96	4.96		
August	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
10				0.96						13.21	12.73
17				0.90						19.64	18.29
Means				(0.93)							
Departures				+.04							

BLUE HILL, MASS.

	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
August	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
7	0.69	(0.78)	0.92	1.08						14.9	13.1
8	.73	(.85)	1.00	1.17	1.32					12.6	12.7
9	.63	.74		1.00	1.35	.85				14.0	12.1
10	.61	.73	.86	1.06	1.36		.92			13.8	12.6
14				1.08			.86			17.7	18.0
15	(.66)	.77	.92	1.12	1.36	1.17	.96	.83	(.73)	15.3	15.3
18						.99	.84	.66	(.55)	16.1	15.8
21	.34	.44	.56	.73	1.10		.41	.28	.21	20.7	21.1
25					.99	.74	.48	.36	.26	23.0	25.1
26			.81	.99	1.18	.77	.61	.51	.37	25.2	24.7
29							.91	.81	.71	23.0	20.5
30	.70	.80								17.3	16.8
Means	.62	.73	.84	1.03	1.24	.90	.75	.57	.47		
Departures	−.02	−.04	−.04	.00	−.06	−.12	−.09	−.11	−.11		

*Extrapolated.
[1] 75th meridian time.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct + diffuse) received on a horizontal surface*

[Gram calories per square centimeter]

Date	Washington	Madison	Lincoln	New York	Fresno	Fairbanks	Columbia	Boston	Nashville	Twin Falls	La Jolla	Riverside	Blue Hill	Newport	Salt Lake City	State College	Davis	Toronto	Ithaca	Boulder	E. Wareham	Honolulu	Pearl Harbor	E. Lansing	Summit	Soda Springs	Grand Lake
1948	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 30	560	713	724	402	727	----	649	578	587	659	610	713	646	594	691	545	660	228	346	640	604	772	599	484	----	----	752
July 31	342	719	616	303	720	----	763	569	----	537	540	695	615	504	660	642	668	651	453	567	466	806	664	586	----	----	598
August 1	71	699	697	113	720	----	649	224	738	612	540	663	203	135	660	629	636	554	488	547	174	682	649	497	----	----	506
August 2	453	556	68	488	720	----	690	434	605	641	493	596	489	542	676	563	674	340	452	495	541	594	448	438	----	----	487
August 3	286	173	159	202	680	----	347	420	432	614	508	640	428	272	509	443	674	342	455	399	394	482	436	237	----	----	535
August 4	105	664	648	149	730	----	410	330	559	537	361	618	316	224	498	427	663	360	417	84	258	166	150	170	----	----	252
August 5	412	698	554	74	720	----	663	409	404	633	287	676	408	381	541	70	657	271	27	344	333	613	634	568	----	----	246
Means	318	603	495	247	717	----	596	423	475	605	477	657	444	379	605	474	662	392	377	440	396	588	511	426	----	----	482
Departures	−161	+119	−26	−204	+47	----	+17	−10	+20	+36	−63	+91	−56	−129	+4	+11	−8	−37	−104	−31	−92	−42	−45	−5	----	----	----
August 6	694	544	89	162	720	----	563	138	622	634	466	652	204	483	557	564	653	475	349	466	511	541	581	488	243	743	600
August 7	465	325	426	618	699	----	322	456	492	620	531	662	577	635	528	475	655	511	440	514	578	718	684	408	327	662	649
August 8	540	361	557	560	739	----	578	581	292	451	609	698	640	652	580	595	625	463	414	485	616	521	643	388	603	733	587
August 9	478	487	465	586	728	----	508	468	574	447	609	692	583	495	678	603	641	548	489	571	429	701	601	506	545	734	492
August 10	483	379	651	568	702	----	618	506	256	601	604	685	585	646	669	687	644	556	488	536	450	620	513	333	412	727	633
August 11	262	402	520	418	702	----	644	485	334	562	514	692	554	642	676	343	641	417	261	447	604	603	481	280	450	726	522
August 12	222	648	538	184	697	----	496	144	461	570	577	679	162	270	660	557	633	421	322	514	253	661	509	363	392	721	548
Means	449	449	464	442	712	----	533	397	432	555	559	680	472	546	621	546	642	484	395	505	492	624	573	395	424	721	576
Departures	−6	−26	−33	+22	+73	----	−7	−9	−23	+4	+38	+136	−11	+54	+1	+72	−10	+44	−55	+16	+28	0	+7	−39	----	----	----
August 13	510	634	566	385	702	----	358	204	356	565	524	619	203	378	649	462	623	346	201	380	322	710	686	290	615	716	451
August 14	534	622	450	596	696	----	405	441	239	606	539	658	574	563	662	543	621	616	366	413	532	714	634	485	613	716	517
August 15	585	591	530	654	688	----	551	590	379	610	598	654	624	651	648	634	646	575	394	635	579	630	583	434	536	721	643
August 16	442	543	650	420	684	----	558	538	582	609	566	646	562	614	646	485	650	541	455	516	572	613	499	443	644	703	462
August 17	340	237	597	282	624	----	645	417	413	612	432	636	474	429	585	533	616	329	287	530	467	613	569	389	609	716	478
August 18	459	603	628	354	672	----	638	482	413	601	380	650	516	592	594	227	627	127	97	324	416	704	628	351	641	709	448
August 19	241	612	591	96	670	----	598	438	457	601	447	634	368	631	639	305	609	255	307	403	537	637	639	442	213	702	483
Means	444	549	573	398	677	----	536	444	406	601	498	642	474	551	632	456	628	399	301	457	489	660	606	405	553	712	497
Departures	0	+90	+80	+13	+52	----	+33	+56	−19	+77	+5	+101	+9	+100	+18	+32	+15	−33	−123	−6	+48	+31	+43	−18	----	----	----
August 20	344	566	510	84	662	----	610	276	585	611	370	608	377	542	622	288	618	480	322	42	549	650	538	502	290	700	685
August 21	386	445	619	532	652	----	447	443	622	593	509	540	540	603	520	457	626	539	319	451	553	628	572	479	575	697	586
August 22	326	550	578	251	651	----	----	420	618	560	590	635	465	544	499	455	564	353	306	455	476	555	527	445	569	412	540
August 23	341	545	595	401	659	----	580	420	488	577	586	666	372	462	559	453	614	453	371	413	412	614	377	385	510	629	324
August 24	479	574	594	366	667	----	620	422	481	587	487	681	474	508	600	452	610	339	329	313	466	306	300	422	165	658	481
August 25	460	579	582	431	640	----	515	424	466	580	445	641	469	491	611	528	580	490	363	380	465	647	508	452	177	665	516
August 26	499	476	394	509	629	----	288	463	406	547	487	500	501	552	600	566	594	467	389	492	512	594	458	330	543	671	463
Means	405	534	553	363	651	----	510	410	524	579	496	623	457	529	573	457	601	446	343	364	490	571	468	431	404	633	514
Departures	−22	+86	+83	−5	+46	----	+66	+40	+64	+54	−5	+94	−15	+71	−9	+28	0	+26	−94	−24	+37	−25	−51	+28	----	----	----
August 27	505	304	438	492	632	----	351	444	549	552	349	586	481	551	606	512	592	317	332	486	454	447	379	350	645	664	527
August 28	520	495	586	405	648	201	469	375	570	509	256	597	380	464	603	493	584	382	284	428	411	612	557	347	601	657	652
August 29	457	439	584	485	623	196	561	482	477	552	224	563	468	540	587	494	526	501	347	494	483	678	614	454	560	612	567
August 30	492	562	538	549	629	199	412	418	384	520	454	558	413	500	449	522	582	161	226	555	427	591	521	314	529	659	659
August 31	327	543	564	431	609	156	572	197	550	477	477	551	196	211	539	507	572	568	265	257	224	596	617	416	580	653	525
September 1	583	270	496	605	602	190	----	554	507	541	339	541	576	617	545	624	579	471	399	260	582	524	463	290	538	655	363
September 2	524	438	466	412	595	173	----	414	543	542	442	553	423	456	535	534	573	339	187	412	439	640	589	280	572	656	530
Means	487	436	525	483	620	----	----	412	511	528	363	564	420	477	552	526	572	391	292	413	431	584	534	350	575	651	546
Departures	+61	+21	+83	+125	+43	----	----	+43	+62	+36	−123	+62	+15	+58	+21	+88	0	−27	−138	−25	+12	+24	+33	−7	----	----	----

ACCUMULATED DEPARTURES ON SEPTEMBER 2, 1948

	Washington	Madison	Lincoln	New York	Fresno	Fairbanks	Columbia	Boston	Nashville	Twin Falls	La Jolla	Riverside	Blue Hill	Newport	Salt Lake City	State College	Davis	Toronto	Ithaca	Boulder	E. Wareham	Honolulu	Pearl Harbor	E. Lansing	Summit	Soda Springs	Grand Lake
	−2520	+5481	+5194	−6671	+11228	----	----	−3941	----	−903	−3395	+13755	−4949	−1400	−602	−2058	−3689	+1939	−10201	----	−2891	----	----	+147	----	----	----

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground, as received on a vertical surface facing south at Blue Hill, Mass., during August 1948*

Date	30	31	1	2	3	4	5	Mean	6	7	8	9	10	11	12	Mean	13	14	15	16	17	18	19	Mean
Gm cal/cm²	269	273	100	254	228	171	235	219	110	281	300	288	286	296	92	236	122	311	326	326	282	313	228	272
Date	20	21	22	23	24	25	26	Mean	27	28	29	30	31	1	2	Mean	----	----	----	----	----	----	----	----
Gm cal/cm²	228	338	302	255	330	308	324	298	316	251	320	273	127	380	291	280	----	----	----	----	----	----	----	----

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, August 1948

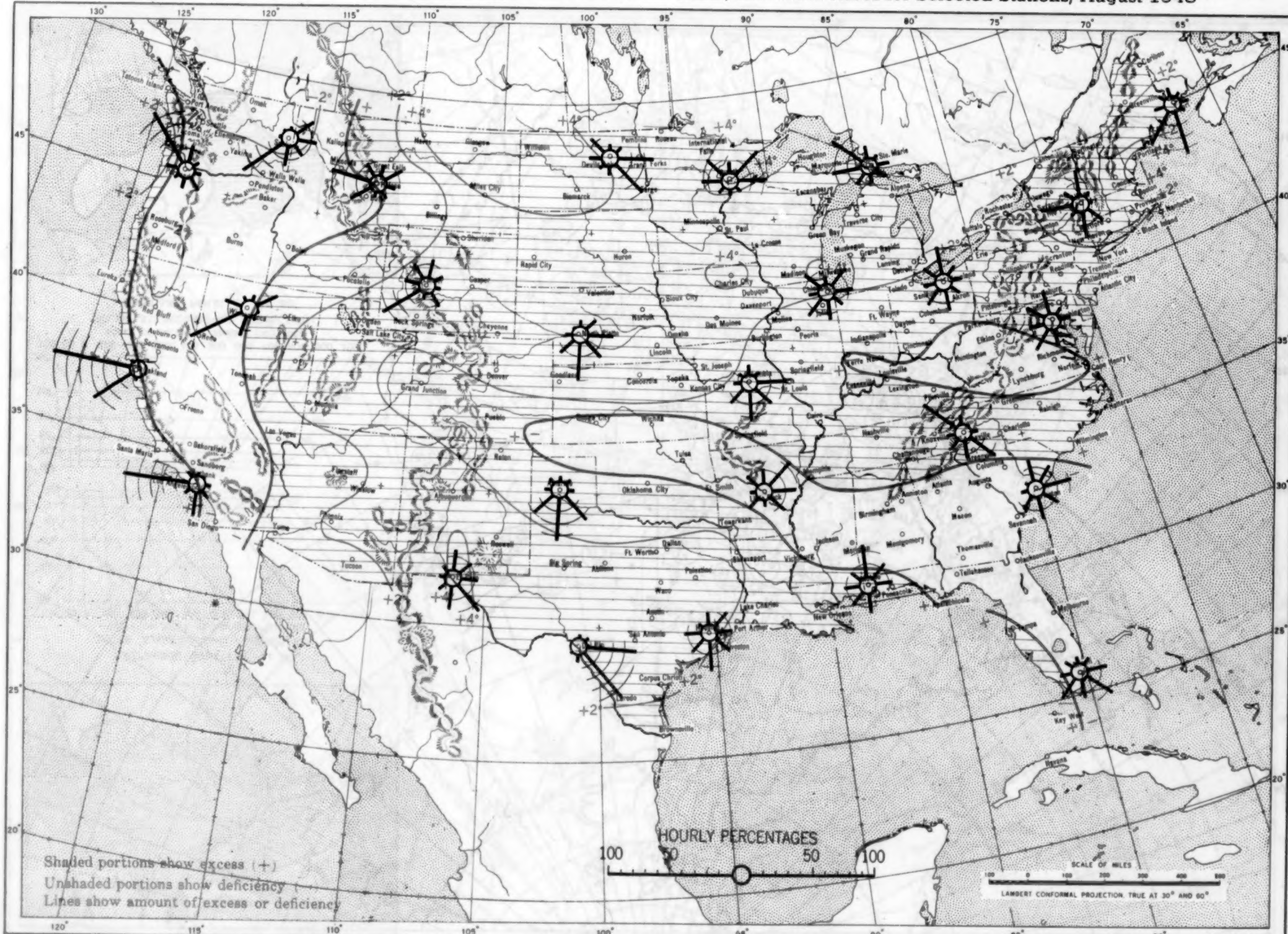
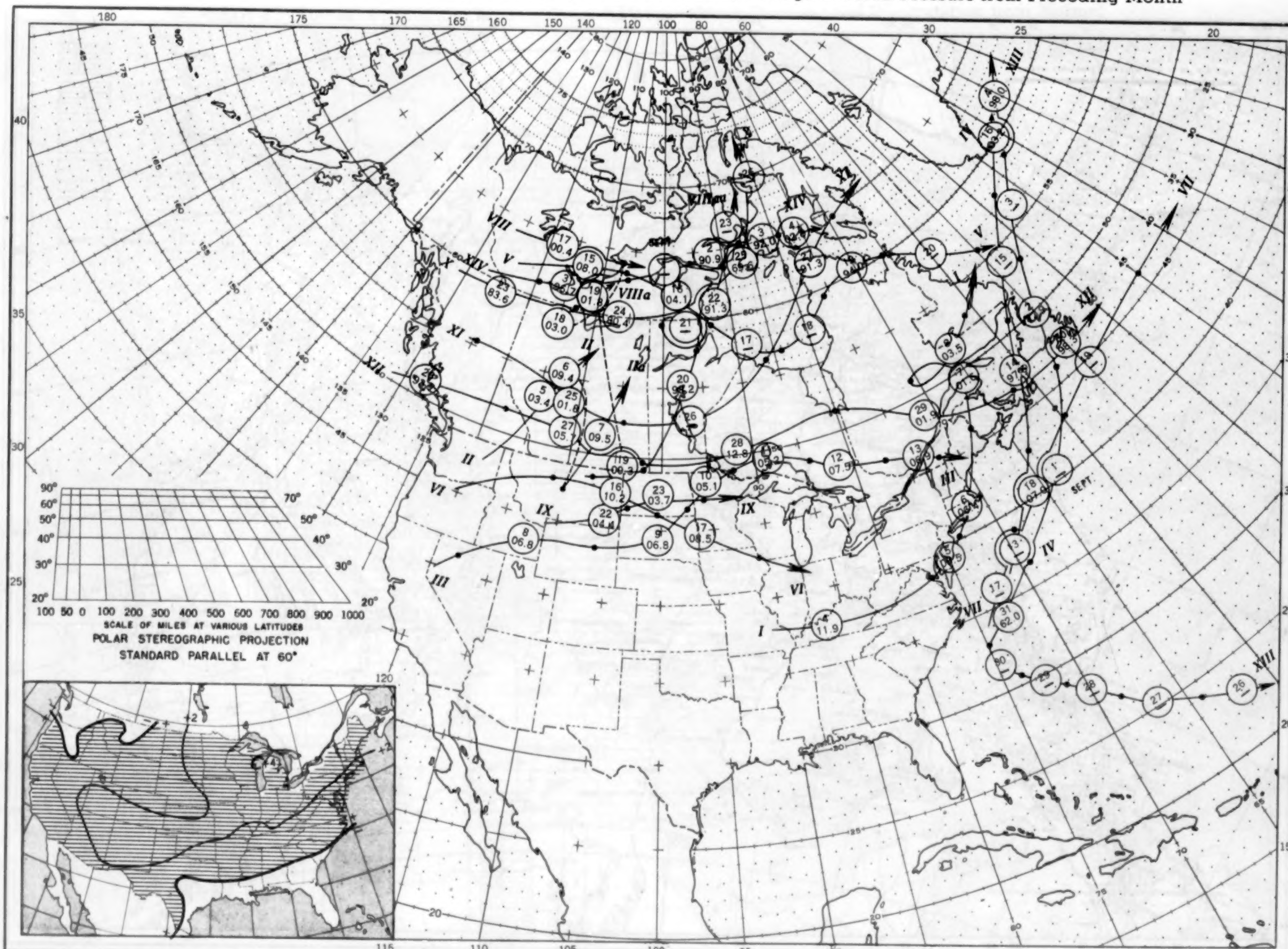


Chart II. Tracks of Centers of Anticyclones, August 1948. (Inset) Departure of Monthly Mean Pressure from Normal

Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time)

Chart III. Tracks of Centers of Cyclones, August 1948. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time)

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, August 1948

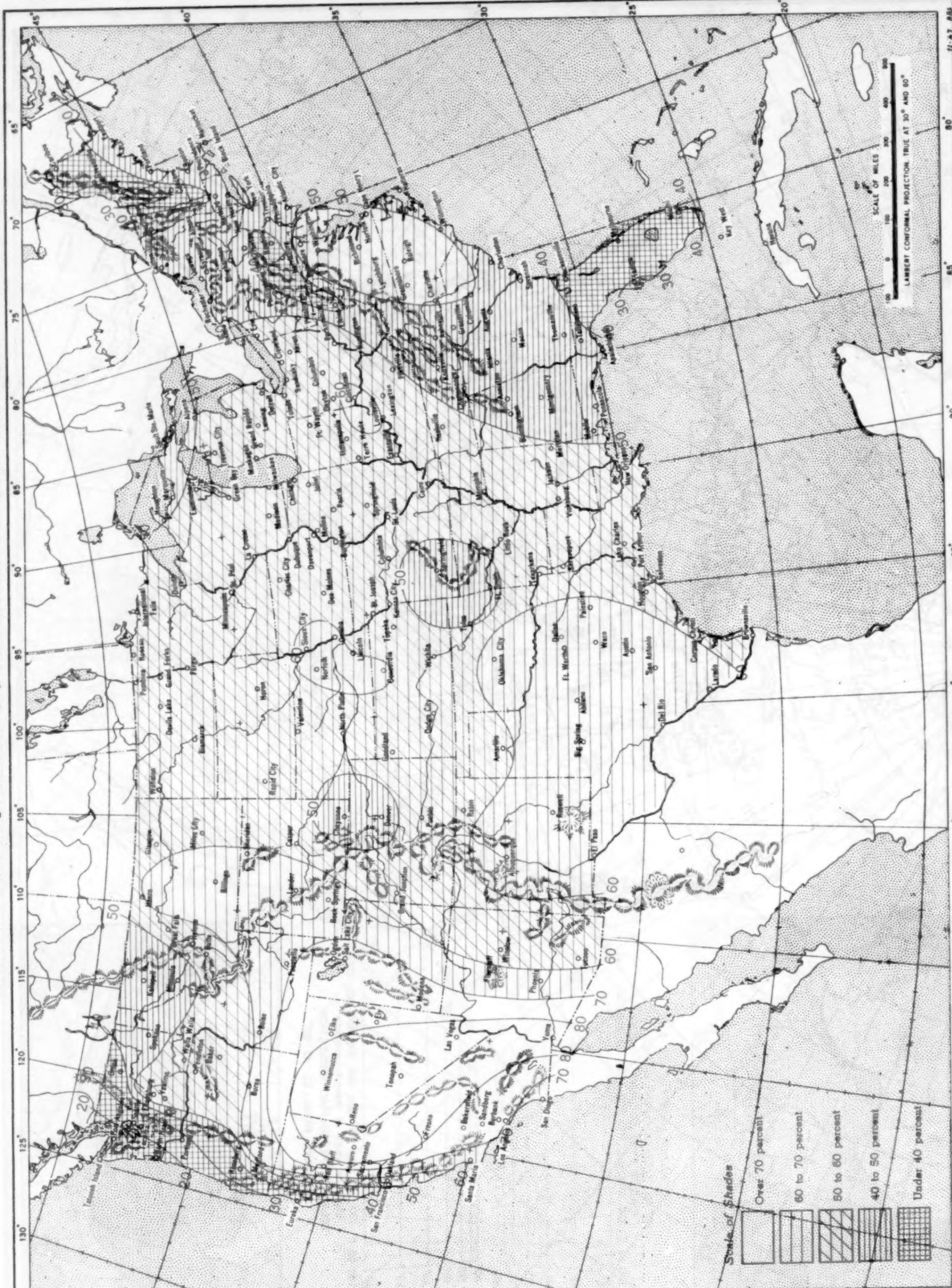
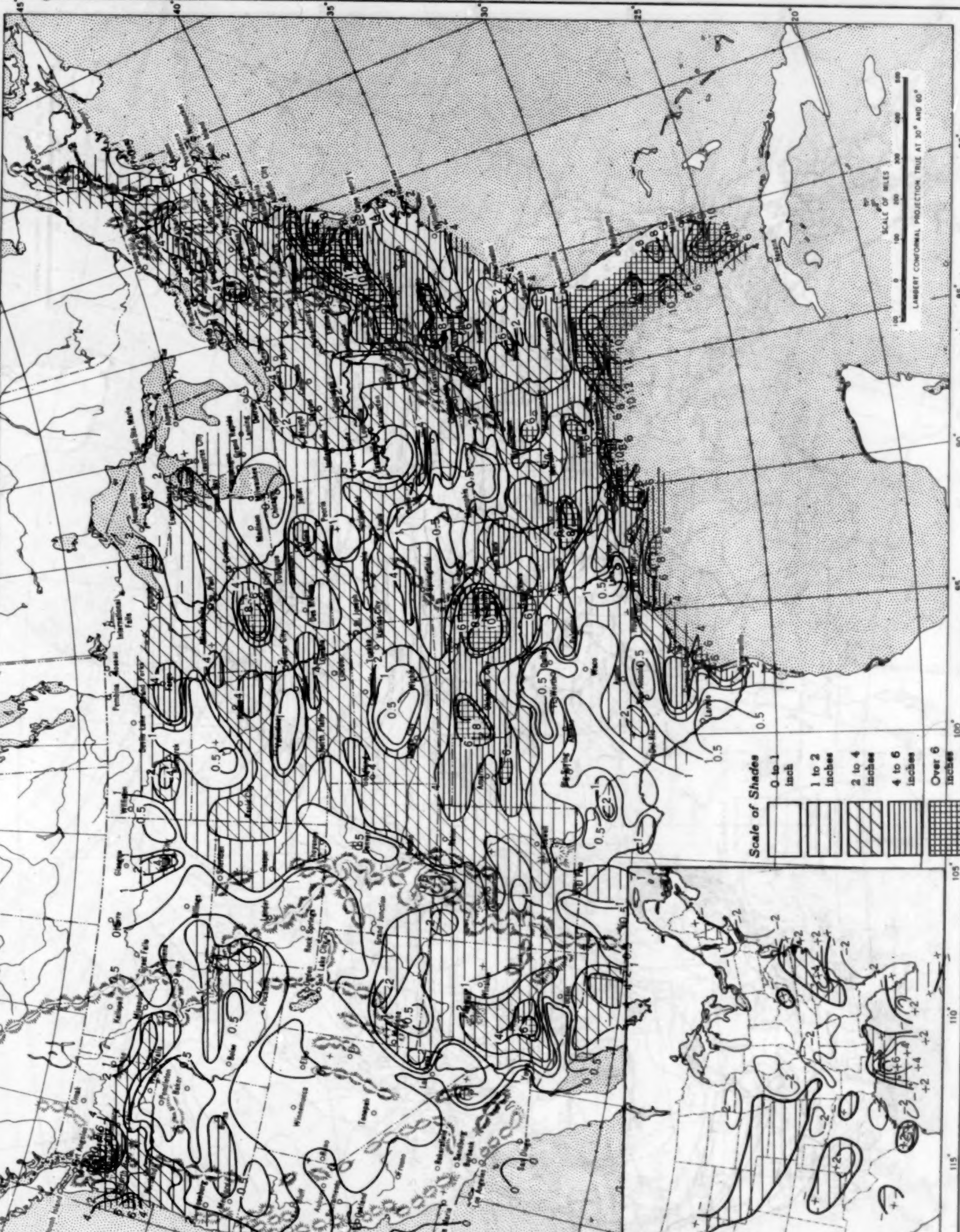


Chart V. Total Precipitation, Inches, August 1948. (Inset) Departure of Precipitation from Normal



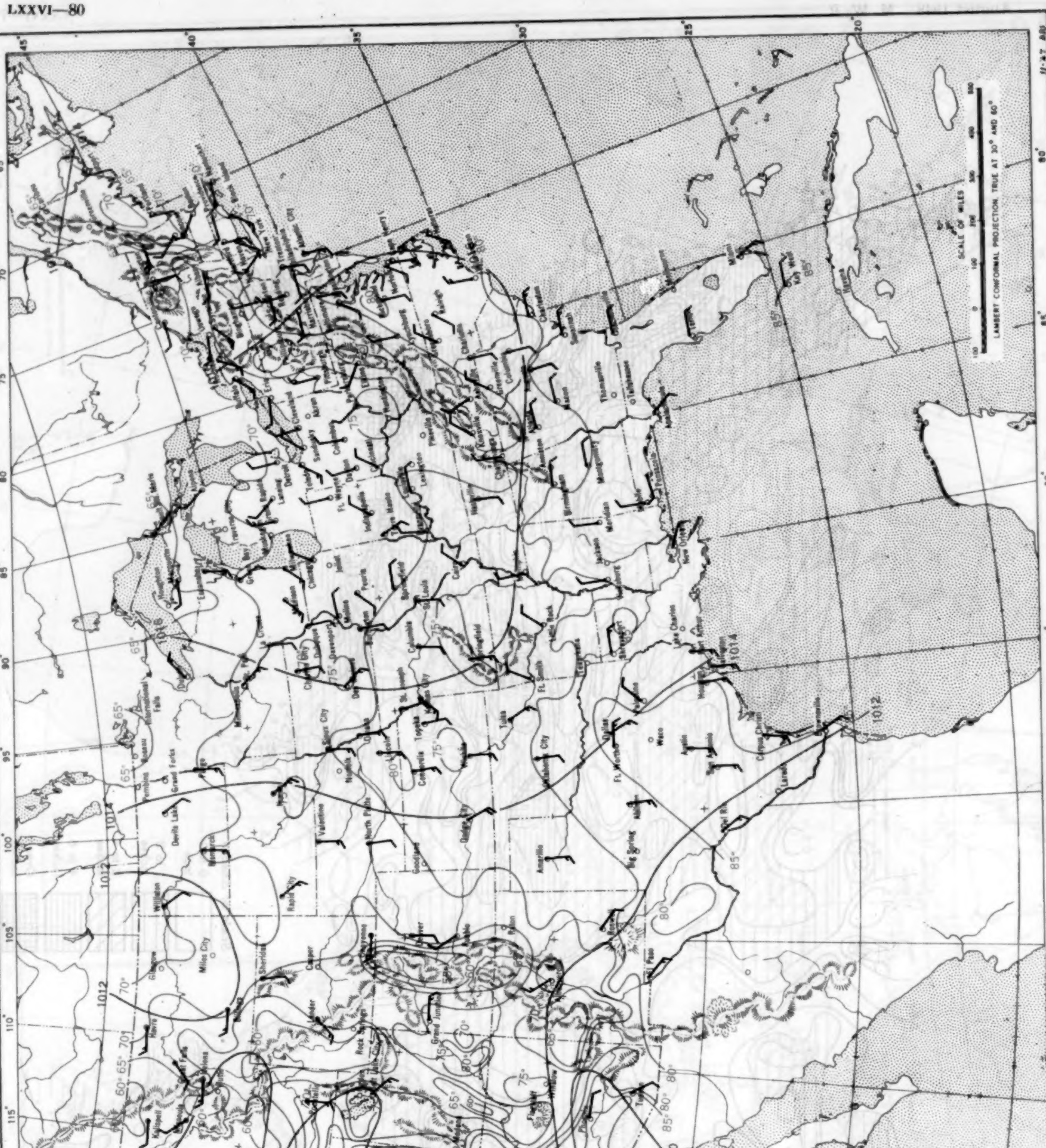
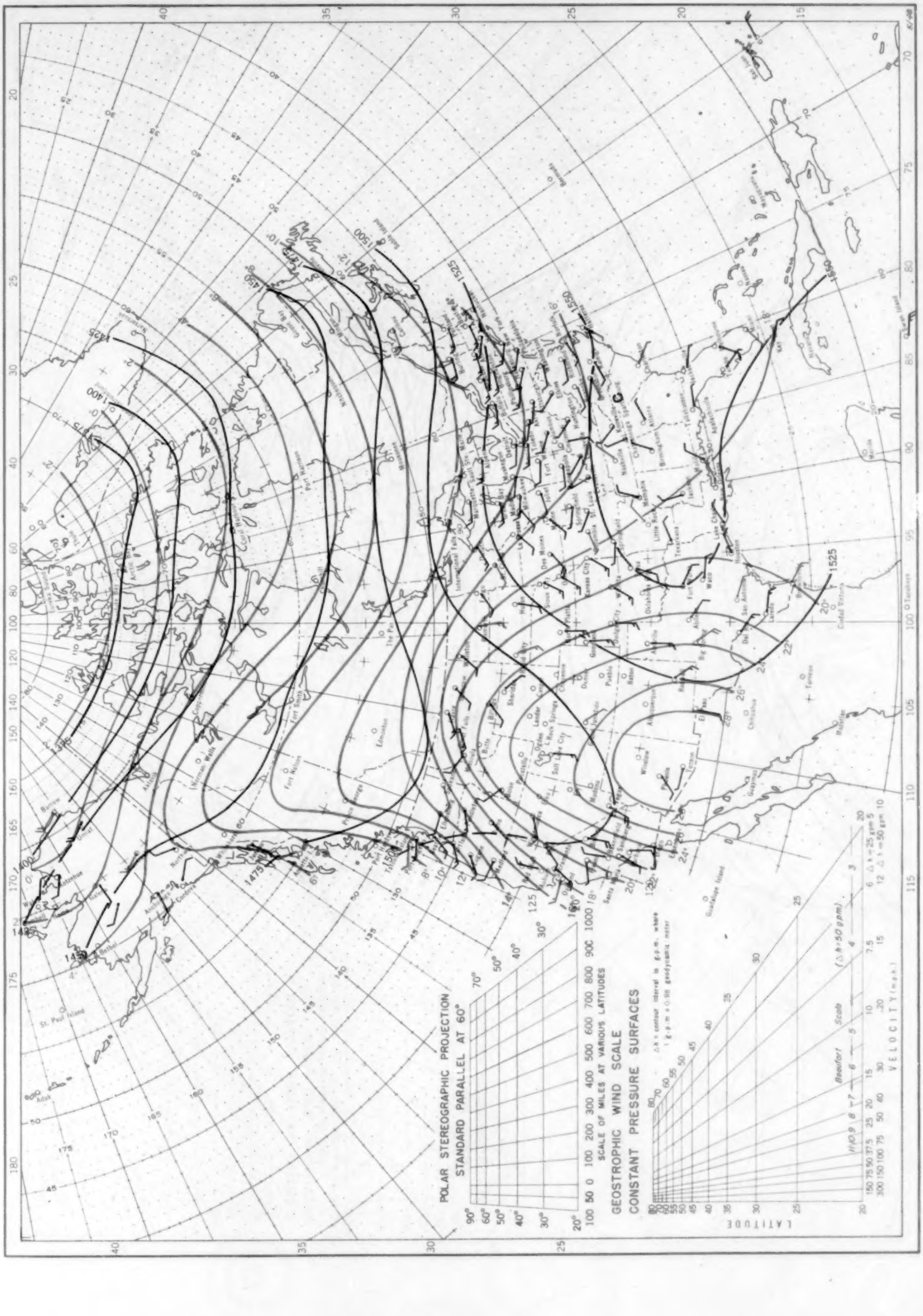


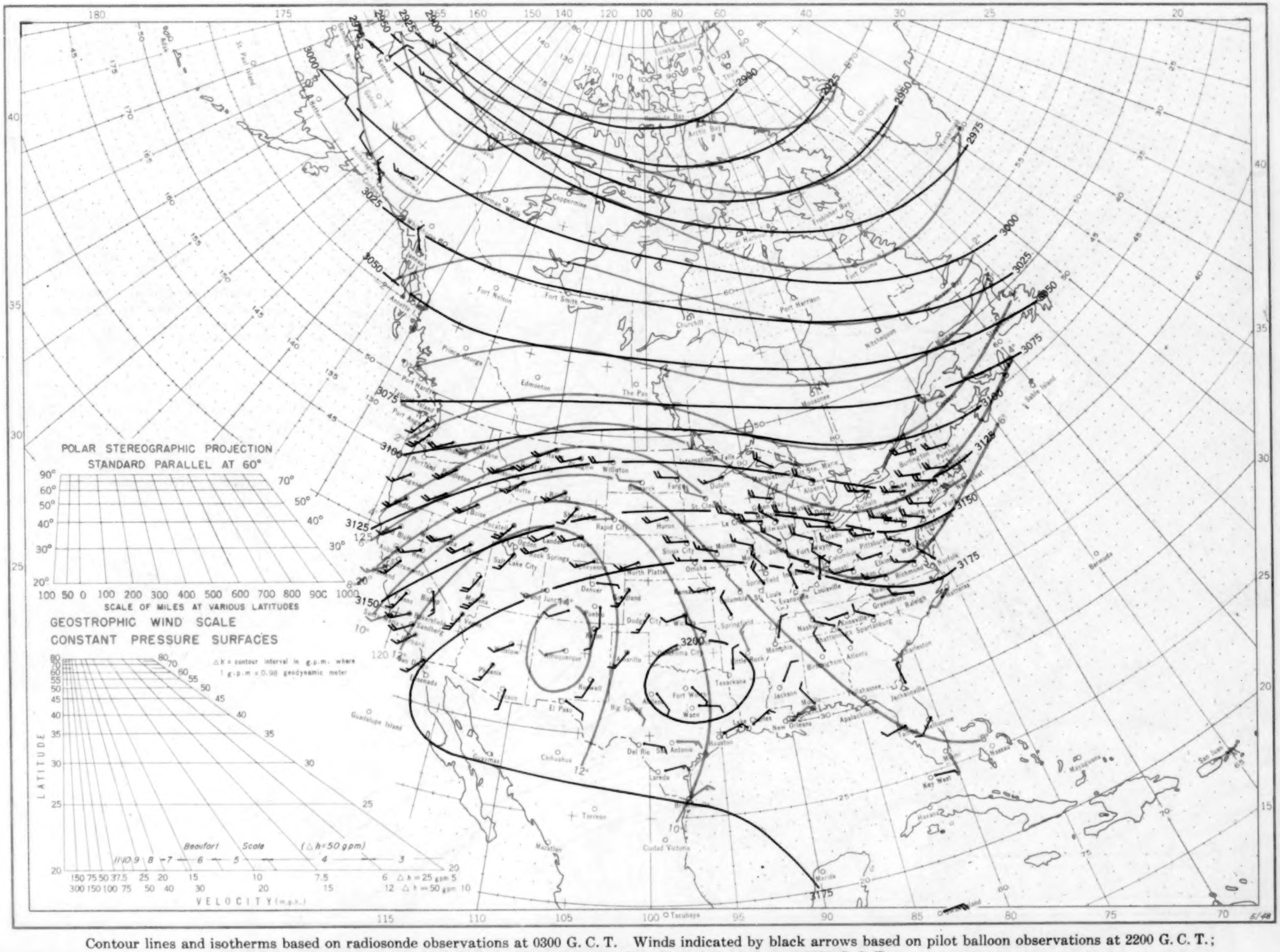
Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface; Prevailing Winds, August 1948

Chart VIII, August 1948. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



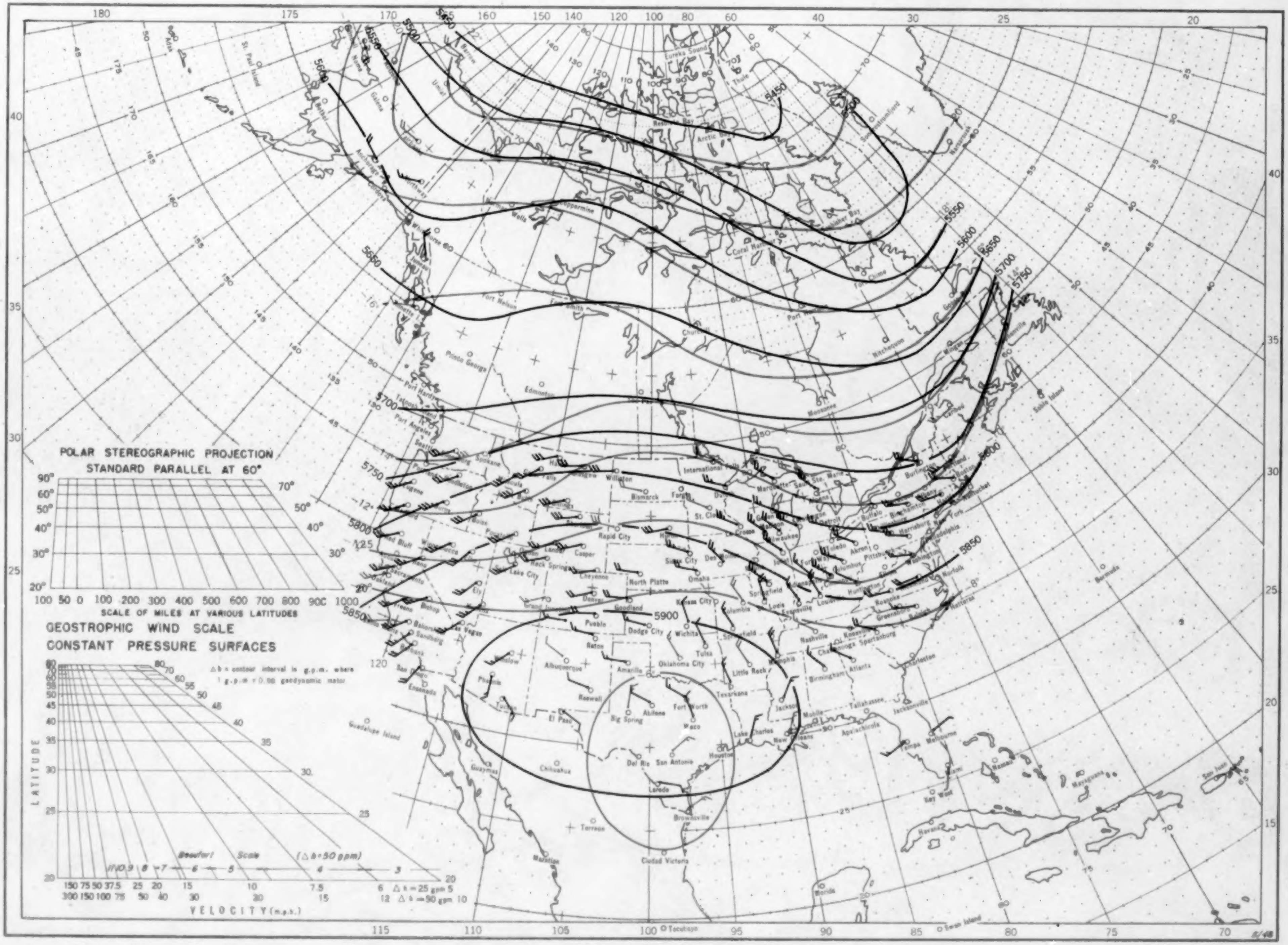
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart IX, August 1948. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



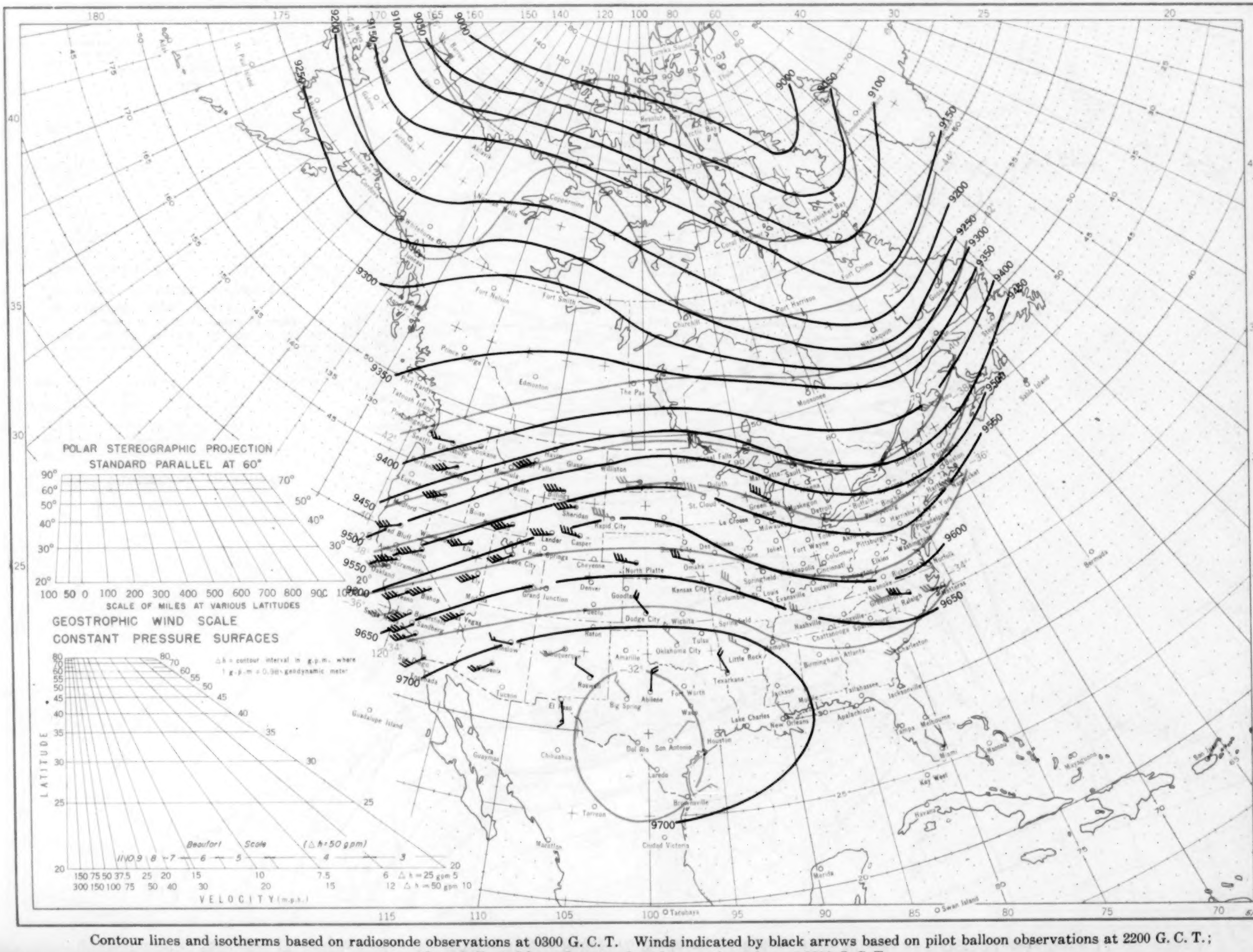
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, August 1948. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, August 1948. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.